MANIFESTO OF STUDIES A.Y. 2023-2024

EDUCATIONAL ACTIVITIES

1st YEAR - MANDATORY COURSES -						
	Course	**Teacher**	**Hours**	**CFU**	**Synopsis**	**Evaluation procedure**
1/A	**Laboratory Safety Course**	Prof. Alessandro Provenzani and Ines Mancini (CIBIO)	12	3	General Laboratory Procedures, Equipment Use, and Safety Considerations. The course consists of lectures and hands-on activities and provides training in chemical manipulation, laboratory activity, biology hazard, fire, and radiation safety.	Biology part: written exam. Chemical part: written exam.
1/B	**Introduction to data protection, security, and privacy**	Lucia Busatta Paolo Guarda Silvio Ranise (UNITN)	12	3	The aim of the course is to provide students with the necessary knowledge of the principles governing (research) data security, privacy, and protection. The first part will deal with research ethics issues concerning the use of data in scientific research and the role of the ethical committee concerning the evaluation of data usage. Secondly, the course will focus on the main contents of the GDPR, in particular with reference to the regulation of privacy in scientific research. Thirdly, the main principles of IT security will be exposed with principles of data protection and practical recommendations for their effective implementation. A case study will be finally presented and discussed with PhD students.	PhD students active involvement in class and discussion of the case study presented at the end of the course.

2nd YEAR - MANDATORY COURSES -						
	Course	**Teacher**	**Hours**	**CFU**	**Synopsis**	**Evaluation procedure**
1	**Scientific Publishing & Communication**	Ralf Dahm (IMB Mainz)	20	4	To be successful, scientists need to raise funding for their projects and effectively communicate their science. No career can be built without writing successful grant applications or publishing high-impact papers, presenting attractive posters, and giving compelling talks. It is therefore essential that scientists learn early on in their careers how best to present their data and ideas in different contexts. This course explains the fundamentals of science communication and fundraising, including: ● The basic principles of good communication ● How to prepare and deliver captivating scientific talks ● How to design appealing posters ● How to write clear and convincing scientific texts, incl. papers and grant/fellowship applications ● How to compile a compelling job application This course will comprise: ● Introductory lectures on the topics outlined above ● Practical sessions during which: - participating students present their projects (in talks or on posters), grant proposals and job applications, and - the tutors and other participants give feedback on a student's presentation/other materials.	Presentations and discussion

BIOMOLECULAR SCIENCES CURRICULUM
OPTIONAL COURSES

	Course	Teacher	Hours	CFU	Synopsis	Evaluation procedure
1	**RNA Molecular Biology and Biotechnology**	Prof. Michela A. Denti (CIBIO)	12	3	The course aims to familiarize the students with cutting-edge new discoveries in the field of RNA biology, and we expect the students to be familiar with the major topics of RNA-based regulation by the conclusion of the course. Topics will include: RNA secondary and tertiary structure; small and large ribozymes; riboswitches; Post-transcriptional gene silencing and RNA interference; RNA splicing modulating therapies; non-coding RNAs.	Presentation of cutting-edge papers, suggested by the teacher and presented by a 30 min journal club by the student.
2	**Chemical modifications and organic synthesis of biomolecules**	Prof. Ines Mancini (Dept. Physics)	12	3	The course will focus on the core principles of synthetic strategy and methodology, with the discussion of recently published topics in the field. Strategies in total synthesis: conversion of functional groups, carbon-carbon reactions, application of organometallic reagents. New methodologies: solvent role and choice, solid supported synthesis, microwave irradiation and other eco-friendly techniques. Asymmetric synthesis: stereoselectivity and introduction of new desired elements of chirality. Asymmetric and bio- catalysis using enzymes and chiral natural molecules. Design and synthesis in modern drug discovery: combinatorial and biomimetic approaches. Click chemistry. Synthesis and characterization of supra-molecular systems. At the request of the student, detailed topics related to his/her PhD research activities can be taken into account.	Individual presentation and critical discussion of an assigned paper or of a selected topic
3	**Origins of Life**	Prof. Sheref S. Mansy (CIBIO)	12	3	In the same year that the Watson-Crick DNA structure was published, another important discover was made. The graduate student Stanley Miller recreated in the laboratory the conditions that he thought best represented that of the early Earth, which included the small, simple molecules water, methane, ammonia, and hydrogen plus simulated evaporative and precipitation processes along with lightning. Miller's experiment revealed that amino acids, one of the key building blocks of life as we know it, naturally emerged from mixtures of simple molecules. Since that time, the field has progressed tremendously. We now have prebiotically plausible pathways for the generation of nucleotides, lipids, and even the formation of protocellular structure. There are still many gaps in our knowledge, but biologists, geologists, chemists, and astronomers are all working to find how life began here on the Earth and how life could emerge elsewhere. Historical and recent research papers will be discussed covering the first genetic	Participation and a journal article presentation

					polymers, what constitutes a living system, and how (proto)metabolism drives the maintenance of a cell.	
4	**From FLIES, FISH, FROGS, and MICE, how to perform cutting-edge science to study human diseases.**	Marie-Laure Baudet Paola Bellosta Matthias Carl Lucia Poggi Giovanni Provenzano (CIBIO)	12	3	This course highlights key strategies and approaches used at CIBIO with our model organisms to advance our understanding of human diseases. First, choosing an appropriate model organism is critical and should align with the research question and disease of interest. Genomic techniques facilitate introducing disease-related mutations or factors, recapitulating human disease conditions. Phenotypic analysis allows the observation of disease-related characteristics, including behavior, physiology, and morphology alterations. Molecular and cellular tudies, with functional genomics studies, including RNA-Seq and CRISPR-based techniques, allow examining gene expression, protein function, and signaling pathways, elucidating the molecular basis of diseases. Multi-omics approaches, integrating genomics, transcriptomics, proteomics, and metabolomics, provide a comprehensive understanding of diseases and their molecular signatures. Advanced imaging and microscopy techniques enable the visualization of disease processes at cellular and subcellular levels. Additionally, collaboration with clinicians and human sample researchers facilitates the translation of findings into clinical applications. Our seminars will show how we use our animal model and the different techniques to understand diseases, from developmental and neuronal defects to inflammation in obesity and cancer.	Presentations of selected papers by the students.
5	**Advanced imaging approaches in Biomedicine**	Alessio Zippo (CIBIO)	12	3	Most important advances in biotechnology and medicine are occurring at the intersection between biology, physics, computer science, and engineering. The course will provide the broad knowledge of the most advance advanced imaging methodology and their applications in biomedical science to compete in this interdisciplinary environment. The program will emphasize concepts and problem-solving attitude over memorization. The student will be exposed to innovative approaches such as super-resolution microscopy, single molecule tracking and optogenetics. We will discuss the advantages of applying molecular biophysical methodologies to address specific biological questions, including macromolecule dynamics. An overview of the challenges and solutions related to quantitative analyses of imaging data will be presented.	Presentation and critical discussion of a paper (during the last 2-hours lecture)

6	**Neural Stem cell**	Luciano Conti (CIBIO)	12	3	The course's aim is to introduce the students to biological properties of neural stem cells and their exploitation for basic and translational applications. Different populations of developmental stage-specific neural stem cell populations will be presented, together with their isolation from mammalian neural tissue. Main emphasis will be devoted to in vitro neural stem cells systems generated starting from pluripotent stem cell.	Presentation and critical discussion of a paper (during the last 2-hours lecture)
7	**Epigenetics mechanisms and their role during Cell Differentiation and transformation, Metabolism, Neuronal diseases**	Marta Biagioli Fulvio Chiacchiera (CIBIO)	12+6	4	When the human genome project was completed it was immediately evident that DNA sequence was not the only matter, but a crucial point was, how are the genes turned on and off to preserve cell identity? The answer is epigenetics, heritable changes in gene expression not caused by changes in the DNA sequence. Of relevance, differently from genetic mutations, epigenetic signatures are reversible and specific enzymes endowed with writer, reader and eraser abilities have been identified. The fundamental role of this class of enzyme has been readily investigated for clinically relevant applications and several “epi-drugs”, able to influence DNA or histone modifications, are currently in clinical trials. But what is epigenetics? The students will revise the molecular structure of chromatin and nucleosomes packaging. They will then familiarize with the most common DNA and histone modifications [5mC and 5hmC, H3K27me3, H3K4me3/2/1, H3K36me3], expression of chromatin-linked noncoding RNAs as well as the usage of different histone variants, evaluating their regulatory role in genomic organization, transcriptional activation, elongation and repression during the normal physiology of the cell. The course will then move to describe 6 different applications of Epigenetics Control, through a series of research seminars by different investigators (*Epigenetics Mondays Seminars*)	Presentations of selected papers by the students.
8	**Regenerative medicine and Artificial Intelligence applications to biomedicine**	Paola Bellosta, Martin Hanczyc, Alessandro Romanel, Luciano Conti, Flavia Ravelli (CIBIO) Antonella Motta (DII)	12	3	These mini-series of lectures aim at showing our view on the future developments in tissue engineering approaches with respect to the fast-moving disciplines that embrace artificial intelligence (AI) and biomedicine. From studies on three-dimensional polymers to the analysis of biological processes, we will talk about our experiments and or applications that study and synthesize “intelligent” materials identified using AI for application in regenerative medicine	The final evaluation will be based on a student group presentation.

9	**Statistical methods for experiment design and data analysis**	Alessio Perinelli (Dept. Physics)	24 (12 of lectures + 12 of hands-on session)	4	The aim of the course is to provide PhD students with a set of tools for designing experiments and performing statistical analyses on the resulting data, with a focus on "few data" experiments. Besides fundamental concepts related to randomness in experimental data, the core topics of the course are hypothesis testing, correlation, regression, and the issue of designing an experiment. The course follows a practical approach: topics are discussed by highlighting applicative aspects; lectures are interleaved with hands-on sessions of examples and exercises. Students are encouraged to propose the analysis of their own data. Basic knowledge of the R programming language is beneficial, though not required. Due to its focus on practical aspects, the course is held synchronously: student attendance is required.	Completion of short assignments during and at the end of the course.

BIO - INDUSTRY CURRICULUM
OPTIONAL COURSES

	Course	Teacher	Hours	CFU	Synopsis	Evaluation procedure
1	**Entrepreneurial Basic Skills for Biotech** **Module 1:** From innovation to a business model	Prof. Alberto Nucciarelli (DEM)	12	3	Purpose of the course is to provide the students basic skills required for the path to entrepreneurship in the biotech sector. The course consists of **three separate modules**: This module defines the path from bio-tech innovation to business modelling in the Biotech industry. To do so, the module stems from the characteristics of innovation to discuss the necessary adherence of a business model to technology and its applications. With the aid of case studies, the module aims to help understand the relationship between innovation and business models choice. This module provides students with the basic knowledge on choosing the right business model for a specific technology and understand main costs and revenue structures supporting a sustainable business model.	
	Moldue2: Working on a business plan	Stefano Milani (Milani & Partners, Milano)	12	3	This module guides students to conceive a business plan. To do so, the module elaborates on the technique of creating a financially sound business plan. The module aims to guide students producing a working business plan to be used for funds seeking and finalising the transition of R&D outcomes to the market. This module provides students with the basic skills to structure a business plan, understand its founding features and present it to potential investors.	
2	**Preclinical research and clinical development programs of drugs**	Prof. Borlak Jürgen (Medical School of Hannover)	12	3	The main objective of this course is to provide an overview of biomedical research strategies and clinical development programs in the drug/ biotech industry. The students will be made familiar with some basic experimental concepts as well as legal requirements for the development of novel drugs. Emphasis is given to the knowledge gain from genome biology and complex data analysis arising from high throughput technologies. *1.* Introduction into basic concepts in preclinical drug research and development *2.* Methods in experimental drug research and clinical development with emphasis on microarray mass spec, high throughput cell biology assays and in vivo imaging modalities	Group exam of n=4 students; students are requested to prepare a 20 min presentation followed by in-class discussion; upon request students can be examined individually.

					3. Genetic models of disease with emphasis on cancer biology and validation of such disease models for the development of novel anticancer drugs *4.* The molecular basis for drug metabolism and disposition including case studies *5.* The molecular basis for drug induced toxicities including case studies *6.* Basic concepts in pharmacogenetics and pharmacogenomics and its application to individualized drug therapies *7.* The application of genomic sciences for improved and individualized drug therapies *8.* Round table discussion with students – and 2 to 3 short presentations from students on selected topics of the course objective.	
3	**Inside Pharmas: Exploring R&D Organizations, Teams, Roles and Drug Portfolio**	Prof. Enrico Domenici (CIBIO)	12	3	The course is designed to provide the student an understanding of the internal environment of pharmaceutical research and development (R&D) organizations and the dynamics that drive innovation, from organizational structures to individual roles and the assessment of drug portfolio values. The course will comprise: - Introduction to Pharma and Drug Discovery - Drivers for Innovation and Organizational Structures - Individual and team roles and responsibilities within a pharmaceutical organization - Biologists in pharma: from basic to translational research and platforms - Collaborative Landscape and partnerships in Pharma - Evaluating Pharma Project Values - Assessing pharma drug portfolio	Student Portfolio Presentations
4	**Liquid biopsy: principles, technologies and diagnostic perspectives**	Salvatore Pernagallo (Destina Genomics)	12	3	Tumours are known to release cells and DNA or RNA into body fluids - it has recently become possible to obtain information about tumours by analysing these circulating elements. To interrogate those elements diagnostic tests, require blood samples, contrasting traditional biopsies that need tumour tissue samples, and are therefore often referred to as liquid biopsies. Tissue biopsy is the 'gold standard' (the most accurate diagnostic test) for cancer diagnosis. However, removal of the tumour tissue by surgery or, in some cases, needle biopsy, is an invasive process. Moreover, the difficulty of reaching the tissue biopsy limits the clinician's ability to take a sample from tumour. The genetic information contained in the tumour cells and their circulating DNA or RNA can provide important clues about the	Journal club – Students will present recent articles regarding liquid biopsy (minimum 4 of IF). This will be held the week after the end of the course

					tumour, such as the likelihood of response or relapse after treatment or response to therapy. Liquid biopsy therefore represents a promising and non-invasive test to be performed in addition to tissue biopsies. Currently, there are two main approaches to liquid biopsy: • Circulating tumour cell (CTC) test that examines whole tumour cells in blood • Circulating tumour DNA (ctDNA) test, which looks for DNA released from tumour cells in the blood Other techniques, such as the observation of cellular fragments called extracellular vesicles (exosomes) or small molecules of non-coding RNA (microRNA), are under investigation. Currently, the medical application of liquid biopsy is limited to defining the prognosis of breast, colon and prostate cancer, and determining the treatment of these tumours and non-small cell lung cancer. **Course overview** This teaching course is aimed to provide a substantive overview of the main approaches in the liquid biopsy field and will offer the possibility to be driven into the latest liquid biopsy techniques. **Learning objectives** After attending this course students will be able to: ● Provide an overall background about liquid biopsy field with particular emphasis on circulating microRNAs. ● Review non-invasive methods to track the molecular profile of cancer by testing liquid biopsies. ● Explore latest technologies for testing liquid biopsies. Learn about some interesting EU project aiming to develop new technologies in the field of liquid biopsy	
5	**Research to business**	Various from HIT - Hub Innovazione Trentino - Fondazione	25	4	This course aims to provide PhD students with the fundamental concepts for helping PhD create impact from their research. In particular Students will be driven to think about the value of their research work in the market. They will explore mega-trends and markets and how to leverage the potential of innovation inside the research. They will investigate with experts the concepts of value proposition and customer, legacies and opportunities related to the IP strategies and protection. Public and private financing strategies and opportunities will be presented. **Main Learning Outcomes** At the end of the classes participants will be able to: - Understanding differences when planning and developing a new entre/intra-preneurial project in different contexts	Attendance is mandatory at least 75% of the meetings.

					- Ability to understand, create, capture value of the research project in a market - Ability to integrate the strategic role of IP and other intangible assets into the research project and future professional scenarios." **Teaching and Learning Methods** Teaching and learning methods are primarily based on applied lectures, testimonials and real case studies from researchers, entrepreneurs, local and/or international business managers. They combine lectures, testimonials from professionals, discussions, individual and group work, hands-on activities and games. Participants will be evaluated with group exercise, and individual reports. Participants will be asked to reflect on their entrepreneurial skills (working in an interdisciplinary team and communicate effectively) and choose one entrepreneurial competence among the ENTRECOMP European framework to improve during the course (self-direct learning).	
6	**Understanding and modeling drug dose-response relationships for drug development**	Luca Gerosa (Genentech)	12	3	This PhD-level course delves into the biology underpinning drug dose-response curves, a pivotal component in the pharmaceutical development process. Utilizing illustrative examples from oncology, the course illuminates the relationship among the drug's mechanisms of action on targets, drug dosage, cellular responses, and therapeutic outcomes. Participants will gain proficiency in understanding and employing tools to quantify drug dose responses from bench data and analyze them using both phenomenological and mechanistic computational models. The course further elucidates the biology of drug resistance and adaptation, equipping researchers with the insights to anticipate and address challenges in drug efficacy. The course will also delve into leveraging drug-dose responses for the exploration of biomarkers, providing a foundation for personalized medicine and targeted therapies. By the culmination of this course, students will be equipped with the knowledge and skills to understand the biology and therapeutic implications of drug dose responses and the key role in the drug development processes. This course is suitable for both experimental and computational biologists with an interest in pre-clinical drug development.	The final evaluation will be based on a student group presentation.
7	**Bioanalytical assay development: from lab innovations to industry transition**	Simone Detassis (OPTOI)	8	2	Academic research laboratories often create new methods and techniques to advance their field of study. These innovations can be used for fundamental science, pharmaceutical and biotechnology companies, and medical applications. Transitioning from academia to industry might be challenging, but with initial careful considerations, it can be much easier. Focusing on methodologies thought to serve the biotech industry or for medical applications, the	the students, in small groups, will follow imaginary case-studies, building a roadmap from scientific discovery to market launch, guided by what

					course will cover basic principles for correct assay development, starting from technical recommendations and definitions (LoD, LLoQ, accuracy, precision, qualification, validation…), to general considerations on regulatory aspects, quality management and production needs. The course is meant to help the researchers to familiarize with formal requirements and definitions that may be encountered during bioanalytical assays development. Additionally, this course will serve as a framework for discovering biotech job positions and roles that may be unknown. General outline: 1. Introduction on bioanalytical assay development. 2. Technical recommendations and needs following FDA and EMA guidelines. 3. Introduction on regulatory and quality management: differences between RUO and IVD. 4. Recognize the value of the assay and general considerations on value proposition, benchmarking, market positioning, patentability.	they have learnt during the course.

QUANTITATIVE BIOLOGY CURRICULUM
OPTIONAL COURSES

	Course	Teacher	Hours	CFU	Synopsis	Evaluation procedure
1	**Introduction to metagenomics**	Prof. Nicola Segata (CIBIO)	12	3	The course will present the state-of-the-art metagenomic approaches for studying the microbial communities (microbiomes) populating the human body and the environment, and will describe the main recent microbial ecology findings, with a focus on those related to human diseases. On the methodological viewpoint, we will present metagenomic tools based on microarray chips, 16S rRNA sequencing surveys, and shotgun high-throughput sequencing from both the experimental and technological viewpoints. An overview of the challenges and solutions for computationally analyzing metagenomic data will be presented including methods for taxonomic characterization, functional profiling, genome assembly, phylogenetic inference of microbiomes. Advanced sequencing-based approaches for pathogen detection and characterization will also be presented. Recent findings about the relation between human associated microbial communities and complex diseases will be discussed as well as the mechanisms of vertical microbiome transmission (e.g. from mother to neonate) and gut microbial colonization.	Presentation and critical discussion of a paper (during the last 2-hours lecture)
2	**Getting started with R and RStudio: a hands-on introduction**	Dr. Pietro Franceschi (Edmund Mach Foundation)	12	3	R is a free software environment, designed for statistical computing which has become a standard for the advanced analysis of biological data. The objective of the course is to provide a "hands-on" introduction to R and RStudio, which will allow the students to 1) familiarize with the environment; 2) load and inspect data spreadsheets; 3) perform basic "data carpentry" operations; 4) visualize the data Due to the “hands on” nature of the course, students are encouraged to bring their own laptop	Practical Sessions
3	**Data Exploration**	Dr. Pietro Franceschi (Edmund Mach Foundation)	12	3	Being able to explore, visualize and interpret complex data is becoming more and more important in biology. With "omic" technologies it is now possible to measure thousands of variables on hundreds of samples, but "big" data can be also produced by many other platforms used to characterize biological samples. The course will focus on data exploration and visualization, introducing some of the bioinformatical and biostatistical	Final test

					tools/concepts which can be used to explore a multidimensional dataset (PCA, Clustering, Linear Modeling, ...). The aim is to highlight the advantages and limitations of each approach. During the course the different aspects will be illustrated by live R sessions on publicly available datasets. The students will be also encouraged to bring their own data to discuss and (possibly) analyze them. Basic knowledge on using R or Python is required.	
4	**Applied Statistics for High-Throughput Biology with Application to Single-cell Sequencing**	Dr. Levi Waldron (City University of New York School Graduate of Public Health and Health Policy)	12	3	This course will provide biologists and bioinformaticians with practical statistical and data analysis skills to perform rigorous analysis of high-throughput biological data, with applications focused on single-cell sequencing. The course assumes some familiarity with genomics and with R programming,but does not assume prior statistical training. It covers the statistical concepts necessary to design experiments and analyze high-dimensional data generated by genomic technologies, including: exploratory data analysis, linear modeling, analysis of categorical variables, principal components analysis and other dimension reduction methods, multiple hypothesis testing, and batch effects. **Introduction** • random variables • distributions • hypothesis testing for one or two samples (t-test, Wilcoxon test, etc) **Dimensionality reduction** • distances in high dimensions • principal components analysis and singular value decomposition • multidimensional Scaling • t-SNE and UMAP **Linear modeling** • multiple linear regression • model formulae • generalized linear models • multiple hypothesis testing **Exploratory data analysis and batch effects** • plots for exploratory data analysis • about batch effects	Evaluation will be based on: ● 4 laboratory assignments (60%) ● a data analysis project (40%)

OPTIONAL COURSES

	Course	Teacher	Hours	CFU	Synopsis	Evaluation procedure
1	**The rules of research: introduction to biolaw and research integrity**	Dr. Lucia Busatta (CIBIO)	6	1,5	This course aims to provide PhD students with some key concepts concerning research integrity and biolaw applied to biomedical research. In particular, PhD students will be guided to understand which are most important legal principles of scientific research, who sets those rules and how they can interact with research activities. The aim is to show that rules governing research are conceived not as a limit to the freedom of the researcher, but as an instrument of guarantee and protection both for researchers and participants. The course will start form an introduction to the main principles of biolaw and bioethics concerning research. Then, the course will ideally follow the path of a research project or of a clinical trial, crossing the most relevant issues that a researcher deals with during the development of a project. The main focus will be on research integrity issues, including research regulation, code of ethics, publication integrity issues, the role of ethical committees, the relationship with research participants (in case of research with the human being). The teaching methodology includes frontal lectures, debates with students and group work	PhD students will be asked to prepare a presentation on a specific issue of research integrity they found during their research project, identifying the legal and ethical problems and proposing a solution. If the number of students attending the course makes it possible, preference will be given to oral presentations. If it will not be possible, students will have to send the presentation or a short paper to the lecturer.
2	**Decoding your science**	Michela A. Denti Marta Biagioli (CIBIO)	12	3	As researchers, we are all confronted, sooner or later, with the need of communicating our results in 'lay language', to convince funding bodies to finance your project, to communicate scientific and clinical advances to patients and patients' associations, to disseminate science to a lay public, to give a press report of your recent paper or to advice policy makers on evidence-based decisions. This course will discuss these needs, highlight basic concepts in Science Communication, and train you on different ways of communicating, depending on the people you communicate to. **General Objectives and Learning Outcomes** □ Providing researchers with the fundamental concepts needed to communicate research. Exploring with experts in communication the different ways we can use to communicate research. Examples of communication strategies will be presented. □ Understand differences when communicating in different contexts and to different audiences.	Participants will be evaluated with group exercises and presentations. Participation is mandatory.

					Use different means and strategies to effectively communicate research. **Teaching and Learning Methods** Teaching and learning methods are primarily based on applied lectures, testimonials and real case studies from communicators, patients' representatives, policy makers, international business and project managers.	
3	**Introduction to the CIBIO Core Facilities**	Facility Managers (CIBIO)	6 each	1 (max 2 per cycle)	The courses will provide an introduction to techniques and instruments related to each Core Facility, together with examples of current applications. Part of the course will be dedicated to the discussion of specific topics and the possibility of a practical session will be evaluated on a case-by-case basis. Cibio Core Facilities are: ● High Throughput Screening (HTS) ● Next Generation Sequencing (NGS) ● Cell Analysis and Separation ● Advanced Imaging ● Mass Spectrometry (MS)	
4	**Make scientific figures better and faster**	Facility Advenced Imaging Managers (CIBIO)	6	1	This course is designed as an introduction to the principles and techniques for visualizing data. The aim of the course is to show how to turn data into publication-ready figures at high quality resolution, using Open Source software. This includes changes to file type, resolution, color space, font, scale, line weights, and layout (to improve readability and professional appearance).	Attendance to all lessons and active participation
5	**Academic writing for Science and Engineering level I**	CLA –Centro Linguistico d'Ateneo	24	3	The course aims to extend students' knowledge of grammatical, lexical and textual features of written academic English in a scientific context and to provide tools to enable students to resolve language questions independently. An active approach is used, with students writing texts related to their academic work and then correcting them individually and as a group. Students should already have a B2 level of English. As the course deals with a restricted version of English, i.e. academic English, the course can also be successfully taken by students with a good B1 level of English and experience with academic English. Most of the course content is at C1 level.	Students are required to complete 4 short written texts, and to revise them to a publishable standard. Texts are evaluated at C1 level. A minimum of 60% is required on the total score for coursework. A minimum of 75% attendance is required.

6	**Presentations for Science and Engineering**	CLA –Centro Linguistico d'Ateneo	16	2	The course aims to give both inexperienced presenters and those with some presenting experience an opportunity to develop their presentation skills and to have feedback on their use of English while presenting. An active approach is used, with students giving presentations on topics related to their research, and giving feedback to others on presentation skills. Students should already have a B2 level of English.	Students are required to complete at least one presentation that is generally comprehensible to the group.
7	**Academic writing II**	CLA –Centro Linguistico d'Ateneo	24	0	The course aims to revise and extend students' ability to use the language and writing skills introduced in the Academic Writing for the Sciences and Engineering course, and to provide support in improving a text they are currently writing, focusing on accuracy and clarity. Particular attention is given to the writing of a literature review. The course is open to students who have passed the Academic Writing for the Sciences and Engineering course (or an earlier version of the course, Technical English or Scientific English.	75% attendance is required. Students are required to bring, and then correct, a text or text extract and to participate actively in class sessions

OTHER EDUCATIONAL ACTIVITIES

Activity	Description	Year	CFU/Period	Evaluation procedure	Mandatory/suggested activity
15 Seminars	Attendance to 15 seminar per year	1st, 2nd, 3rd	1/year	Evaluation form	mandatory
Summer School		anytime	2 total	Certificate provided by the organizing institution	

RESEARCH ACTIVITIES

Activity	Description	Year	CFU/Period	Evaluation procedure	Mandatory/ suggested activity
General Laboratory Safety course	This course satisfies initial awareness training specified by the laboratory health and safety law and standard for personnel working in laboratories at the University of Trento. The course addresses the importance of health and safety, what accidents and work-related ill-health are, and why they occur. It will introduce to different risk range (chemical, physical, electrical, ionizing/radiation, biological and mechanical) of health and safety hazards and the harm they can do as well as their reduction/prevention. It explains the principles of Personal Protective Equipment (PPE) required for many work procedures in the laboratory environment, with emphasis on training in the maintenance, fit, and use of specific PPE for different work activities.	Anytime	1	Online test	
Journal Clubs		1st, 2nd, 3rd	1/year	Presentation	mandatory
1 progress report (WIP)		1st, 2nd, 3rd	3/year	Presentation	mandatory
Research period abroad			6/month	Written report	mandatory (at least 1 month)
Publication (1st author)	International peer reviewed journals		3 each	Publication accepted	
Publication (co-author)	International peer reviewed journals		2 each	Publication accepted	
Abstract or presentation at congresses			1 each	Abstract or presentation submission	
Teaching support activity	At High Schools/University		1/assignment	Certified	
Event organization (e.g. PhD Colloquia)			1 each	Certified	suggested
Tutoring	Tutoring undergraduate students		1 each B.Sc. student 2 each M.Sc. student **Max 3 credits total**	Certified	

Each PhD student is required to obtain a total number of 60 CFU per year (educational and research activities) for a total of 180 CFU split as follows:

- 20 CFU for educational activities:
  - 7 credits for mandatory courses
  - 3 credits from seminars
  - for each Curriculum 6 credits for courses chosen among the dedicated courses list (Biomolecular or Bio-Industry or Quantitative Biology)
  - 4 credits for courses chosen among all the courses.

- 160 CFU for research activities

Regarding the **Educational Credits**:

- Credits for the institutional courses are specified in this Manifesto of Studies and have value in the year in which the course is attended.
- For the recognition of the credits obtained from courses organized by:
  a) other Doctorates,
  b) research Institutes,
  c) Universities (master's degree)
  approval of the PhD Committee or the Executive Committee will be needed.
- **It is mandatory to obtain at least 10 educational CFU within the first year of the Doctorate**.

Research CFU comprise the mandatory research activities listed above plus the optional research activity and the regular lab activity.