MANIFESTO OF STUDIES A.Y. 2018-2019

EDUCATIONAL ACTIVITIES

	1st YEAR - MANDATORY COURSES -					
	Course	**Teacher**	**Hours**	**ECTS**	**Synopsis**	**Evaluation procedure**
1	**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.
2	**Laboratory Techniques**	Various	6	1	Procedure relative to the PhD project.	Approval by the tutor

	2nd YEAR - MANDATORY COURSES -					
	Course	**Teacher**	**Hours**	**ECTS**	**Synopsis**	**Evaluation procedure**
1	**Scientific Publishing & Communication**	Marie-Laure Baudet Massimo Pizzato Martin M. Hanczyc Sheref Mansy (CIBIO)	12	3	The proposed course aims to convey the basic skills needed to publish and communicate scientific results. It combines lectures, which will explain the basic principles of good writing practice and presentation skills, with practical parts during which the students will apply their newly acquired knowledge.	Practical sessions

BIOMOLECULAR CURRICULUM OPTIONAL COURSES						
	Course	**Teacher**	**Hours**	**ECTS**	**Synopsis**	**Evaluation procedure**
1	**Biostatistics** **Module 1**	Prof. Claudio Agostinelli (Dept. Mathematics)	6	1	Review of statistical inference: point estimation, confidence intervals, hypothesis testing and p-value using the likelihood approach. The module is mainly based on computer sessions.	Weekly homework
	Module 2	Prof. Claudio Agostinelli (Dept. Mathematics)	12	2	Linear models, Batch effects and confounders. Logistic regression, regression for counts and Generalized Linear Models. Multiple testing and p-value. The module is mainly based on computer sessions.	Weekly homework
2	**Bioinformatics** **Module 1:** Machine learning techniques for classification and regression tasks in bioinformatics	Prof. Enrico Blanzieri (ICT)	8	1	The module will cover data and nature of the tasks, local, max-margin, and neural techniques for solving them. We will also illustrate examples from SVMs for RNA-protein binding prediction to the recent applications of deep learning to protein function classification.	Students will be required to review a paper on the topics discussed during the lessons.
	Module 2: Probabilistic graphical models for bioinformatics	Prof. Andrea Passerini (ICT)	6	1	The basic principles underlying Bayesian Networks will be presented: representation formalism, independences, basics of inference and learning. Hands-on experience in developing and using Bayesian Networks will be provided. Finally, profile Hidden Markov Models for biological sequences will be discussed.	Students are required to accomplish a small project using Bayesian Network software and write a 3/4 pages report.
	Module 3: Artificial intelligence techniques for the analysis and interpretation of single cell sequencing data	Dr. Toma Tebaldi (Yale University)	6	1	Thanks to the revolution of single cell sequencing, today we can obtain genomic and transcriptomic sequencing data from single cells. By looking at thousands of cells one at a time, we can see which set of genes each individual cell is transcribing, and we can capture the cellular diversity of human tissues with unprecedented resolution. Single cell data analysis requires the development of appropriate methods, for example for cell type identification and inference of gene regulatory networks. We will present, discuss and test some of the available techniques addressing the analysis of single cell sequencing data.	Students will be required to review a paper on the topics discussed during the lessons

3	**Molecular Spectroscopic Techniques**	Prof. Graziano Guella (Dept. Physics)	12	3	The lessons include principles and applications of molecular spectroscopy for the elucidation of bioorganic structures and binding phenomena. Main emphasis will be on modern applications of Nuclear Magnetic Resonance and Mass Spectrometry in biochemical contexts but fundamentals of electronic and vibrational spectroscopy will be also presented. *Molecular spectroscopy***.** *Mass Spectrometry* *Principles of Nuclear Magnetic Resonance (NMR).*	Individual reports and discussion on assigned topic & participation.
4	**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.
5	**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)

6	**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.	Presentation and discussion of an assigned paper
7	**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 polymers, what constitutes a living system, and how (proto)metabolism drives the maintenance of a cell.	Participation and a journal article presentation
8	**Getting started with R and RStudio: a hands-on introduction**	Dr. Pietro Franceschi (Edmund Mach Foundation)	6	1	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	Practical Sessions

9	**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 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/Python sessions on publicly available datasets. The students will be also encouraged to bring their own data to discuss and (possibly) analyse them. *Basic knowledge on using R or Python is required.*	Individual/Group reports and discussion on assigned topics

10	**Applied Statistics for High-Throughput Biology**	Dr. Levi Waldron (City University of New York School Graduate of Public Health and Health Policy)			This course provides biologists and bioinformaticians with practical statistical and data analysis skills to perform rigorous analysis of high-throughput biological data. It covers essential statistical concepts behind the design of experiments and analysis of high-dimensional data generated by genomic technologies, including: sampling theory, linear modeling and confidence intervals, hypothesis testing, analysis of categorical variables, and methods of resampling (Monte Carlo, permutation tests, and bootstrap). The course assumes some familiarity with genomics, but does not have formal pre-requisites. Some prior exposure to the R statistical programming language, such as provided by the datacamp.com introductory course, will be very beneficial.
					<u>Topics</u>
					• Introduction
					  ○ introduction to R
					  ○ random variables
					  ○ distributions
					  ○ populations and samples
					• Fundamentals of hypothesis testing
					  ○ Central Limit Theorem
					  ○ t-distribution
					  ○ type I and II error and power
					  ○ confidence intervals
					• Linear modeling
					  ○ model matrix and model formulae
						Evaluation will be based on:
						• Completion of laboratory exercises due at the starts of sessions 2 and 3 (40%)
						• A data analysis project assigned in session 3 and due one week after the final lecture (60%)

					• Hypothesis tests for categorical variables (chi-square, Fisher's Exact Test)
					• Resampling-based statistical methods
					  ○ Monte Carlo simulation
					  ○ permutation tests
					  ○ bootstrap simulation	

11	**Post-translational modifications of proteins in the control of cellular homeostasis and cancer**	Prof. Stefano Ferrari (University of Zurich)	12	3	This series of lectures will extend and refine basic knowledge on the upward causation of life (i.e., DNA->mRNA->Protein) that students acquired in basic molecular and cell biology courses. Students will be introduced to cutting-edge studies on protein post-translational modifications (PTMs) as explanation of the increasing complexity observed during evolution from single cell to multicellular organisms and as efficient means to control cellular functions in normal and pathologic conditions. The lectures will provide a historical perspective on PTMs and examine mechanistic aspects of phosphorylation, ubiquitylation and SUMOylation as PTMs that occur in hierarchical, synergistic or antagonistic combinations, defining codes that translate into well-defined outputs. In depth examination of the control of complex processes such as the cell division cycle and the DNA damage response will provide practical examples on the importance of PTMs in signaling and cellular responses. Special emphasis will be put on pharmacological approaches in cancer therapy where components of signaling pathways have been successfully targeted. Part of the course will be the analysis of a seminal article (Journal club format) and a workshop consisting of tasks assigned to the students (Flipped classroom concept).	Ongoing assessment (Journal club/Workshop) and final written exam
12	**Developmental Biology. Mini series of talks**	Marie-Laure Baudet Paola Bellosta Yuri Bozzi Matthias Carl Simona Casarosa Lucia Poggi Giovanni Stefani (CIBIO)	12	3	It is not birth, marriage or death, but gastrulation which is truly the most important time in your life" (L. Wolpert). Developmental biologists investigate how morphogenetic, signaling, and proliferation/differentiation processes are coordinated during embryogenesis to facilitate the generation of a fully functional animal from a single fertilized egg. This knowledge is central to understand the complex pathophysiology of diseases that are frequently caused by developmental defects. This mini series of seminars/lectures aims at providing a contemporary view on fundamental developmental processes, from the growth control of organs such as the eye and brain and the emergence of neurons and neuronal connectivity within, to the processes leading to aging, and aspects of cognitive neuroscience. The lectures include state-of-the-art research at CIBIO involving	Presentations of selected papers by the students.

					animal models commonly used for developmental studies. In particular, the latter will help attending students to re-evaluate the great potential of the Institute for collaborative research activities invaluable for their own research. Each lecture will be accompanied by papers sent in advance to the students to facilitate and promote discussion	
13	**Cancer Models**	Prof. Maria Caterina Mione (CIBIO)	12	3	The course focuses on in vivo models as experimental tools in cancer research. It will explore the ethics of using animal models, the usefulness of the models and the potential benefits for human health. Topics include: genetic models in cancer research (mouse, drosophila and zebrafish), tools for genetic manipulation, spontaneous/induced mutations, transgenesis, clonal analysis. Experimental models to study metastatis, immune responses, and personalized medicine.	Presentations of selected papers by the students in a minisimposium, roundtable and working groups.
14	**Genomic and proteomic biomarkers: from target discovery to drug development applications**	Prof. Enrico Domenici (CIBIO)	12	3	The objective of the course is to introduce the concept of biomarkers, with a particular emphasis on disease and clinical response biomarkers, and their applications in the identification of novel therapeutic targets and patient stratification strategies. A number of examples of genome- or proteome wide-approaches for biomarker discovery and validation will be provided and their potential impact in drug discovery will be highlighted. A special focus will be given to translational neuroscience biomarkers and their promise to personalized therapies. Biomarkers and Translational approaches • definition and field of applications • biomarker needs in neuroscience Biomarker investigations by expression analysis • genomics, proteomics and metabolomics approaches in biological fluids • examples from neurodegenerative and neuropsychiatry disorders Genetic biomarkers • from GWAS to patient stratification strategies	The evaluation will be based on small group journal clubs focusing on specific biomarker topics, where each student will be assessed for group and individual effort.

15	**Molecular Phylogenetics and Evolution**	Dr. Omar Rota-Stabelli (Edmund Mach Foundation)	12	3	Evolution can deepen our understanding of biological processes by revealing how (and when) things come to be the way we currently observe them. A useful evolutionary tool is molecular phylogenetics, the study of evolutionary relationships among molecules. This introductory course will provide the theoretical and practical bases of phylogenetics by 1) introducing the bases of phylogenetics, 2) addressing how to do deep-time phylogenies (relationships among distantly related species) and shallow-time phylogenies (relationships among closely related strains), and 3) putting time back into phylogenies (estimating divergence times aka molecular clocks). Although mostly theoretical, the course may have some hands-on components depending on students' feedback.	Attendance to all lessons, active participation, and a two page report on how to build a dated phylogeny using BEAST

BIO - INDUSTRY CURRICULUM OPTIONAL COURSES						
	Course	**Teacher**	**Hours**	**ECTS**	**Synopsis**	**Evaluation procedure**
1	**Managing Pharma: from Idea to the Market** **Module 1:** Managing Innovation in Pharma R&D	Dr. Lucio Da Ros (ViiV Healthcare Verona)	12+12	3+3	Purpose of the course is to provide the students the understanding of the multifaceted aspects of modern pharmaceutical industries, with emphasis on R&D Processes, organizational approaches, new product development strategies and trends. Students will benefit from a multidisciplinary learning path for expanding their career options within the biopharma industry. This track facilitates a thorough assessment of the GxP processes to emphasize the relevance of regulated activities as a cornerstone for transforming scientific breakthrough into innovative products. The course is based on **two integrated modules**: <u>Module 1:</u> • Overview of the drug discovery and development process • Pharma R&D business models & organizations • Improving R&D productivity • Evaluation of Innovation in response to unmet medical needs • Project Management in Drug Discovery and Development • Managing Pharma R&D portfolio	

	Module 2: From Clinical research into the market	Prof. Alessandro Provenzani (CIBIO)			Module 2: • Overview of the pharma company workflow between departments and manufacturing sites • Roles of regulatory entities in the approval of a New Chemical Entity (NCE) • The role of Quality Assurance • Regulatory requirements: from the Investigational New Drug (IND) filing to the Common Technical Document (CTD) Monitoring clinical trials and CRO	
2	**Entrepreneurial Basic Skills for Biotech** **Module 1:** From innovation to a business model	Dr. Alberto Nucciarelli (Dept. Economics and Management, Unitn)	16	4	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.	
	Module 2: The legal protection of inventions	Simonetta Vezzoso (Dept. Economics and Management)	8	2	This module provides general knowledge on Intellectual Property Rights (IPR). To do so, the module stretches the importance of protecting research outputs with patents and informs attendees on how to extract value from them. This module also aims to inform students about rights conferred by patents, patentability requirements, patents infringement, as well as patents application requirements to the European and the American patent office. This module provides students with the essential elements to understand the relevance of protecting inventions with Intellectual Property Rights and extracting meaningful value from them.	
	Moldue 3: 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.	

3	**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 *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 individualised 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.	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.

OPTIONAL COURSES						
	Course	**Teacher**	**Hours**	**ECTS**	**Synopsis**	**Evaluation procedure**
1	**Directed Reading**	Various	12	2	The aim of the course is to help PhD student get deeply acquainted with the general literature of their specific field of research. The student will be invited to meet with their supervisor on a regular basis (e.g. every week) to discuss key findings and related publications. The student will thereafter be asked to write a 30-40 page literature review including illustration (excluding references). This document could serve as a thesis introduction.	Approval by the tutor: The supervisor as well as an internal examiner will grade the literature review

2	**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.
3	**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.
4	**Academic writing for Science and Engineering level 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
5	**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)	Attendance to all lessons and active participation

6	**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

OTHER EDUCATIONAL ACTIVITIES					
Activity	**Description**	**Year**	**ECTS/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	ECTS/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 o 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 ECTS per year (educational and research activities) for a total of 180 ECTS split as follows:

- 20 ECTS 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)
  - 4 credits for courses chosen among all the optional courses

- 160 ECTS 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 Degree) approval of the PhD Committee or the Executive Committee will be needed.
- **It is mandatory to obtain at least 10 educational ECTS within the first year of the Doctorate**.

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