MANIFESTO OF STUDIES A.Y. 2017-2018

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.
2.	**Laboratory Techniques**	Various	12	3	Procedure relative to the PhD project.	Approval by the tutor

	2nd YEAR - MANDATORY COURSE-					
	Course	**Teacher**	**Hours**	**ECTS**	**Synopsis**	**Evaluation procedure**
1.	**Scientific Publishing & Communication**	Dr. Ralf Dahm (IMB Mainz)	24	4	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. The target audiences of the course are PhD students, but the course will also be open to select Master's students and junior postdoctoral scientists.	Practical sessions

	OPTIONAL COURSES					
	Course	**Teacher**	**Hours**	**ECTS**	**Synopsis**	**Evaluation procedure**
1.	**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.
2.	**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.
3.	**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

4.	**Statistical Models**	Prof. Claudio Agostinelli (Dept. Mathematics)	6+12	3	Module 1 (6hours) The module is a crash course on statistics and linear models. Basic concepts such as estimation, confidence intervals, and p-value are briefly reviewed (2hours). The linear models is presented from a practical point of view using R on simple cases, including aspects of Analysis of Variance (ANOVA), diagnostics and alternative estimation procedure (4hours). Module 2 (12hours) The module aims to provide an insight on generalized linear models and to give practical experience on the analysis of data with modern statistical, packages. Emphases are placed on rationales, assumptions, techniques, and interpretation of results from computer packages. The lectures cover computer usages, such as R, and the students are expected to work with R throughout. We will focus our attention on extending linear "regression" model to a wider range of data structures and measurement approaches. We will see how to deal with nominal and ordinal dependent variables, and dependent variables that may be continuous, but should not be assumed to be normal. If time permits, we will also survey some of the issues arising from the non-independence of observations. Such non-independence most commonly arises from repeated observations of same cases (repeated measures), nesting of observations (contextual or hierarchical or clustered sampling), or spatial proximity of cases. Previous knowledge: Students should have basic knowledge on linear algebra, probability and statistics. Basic knowledge of R, unix-like operating system and LaTeX would be greatly appreciated.	Module 1: A project consisting on analyzing a data set using linear model technique. Module 2: A project consisting on analyzing a data set using a generalized linear model technique.
5.	**Bioinformatics**	Prof. Enrico Blanzieri (ICT) Prof. Andrea Passerini (ICT)	12	3	Design of microarray experiments. Normalization of microarray data. Loess. Significance of Analysis of microarray data, t-test, SAM, Cluster Algorithms. Kmeans. Hierachical Clustering. Distances used in clustering. Use of R for microarray data analysis. Probabilistic graphical models: probabilistic inference, structure and parameter learning. Hidden Markov Models for biological sequence analysis: Pair-HMMs, Profile HMMs.	Probabilistic graphical models: Bayesian network project.
6.	**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.
7.	**RNA Molecular Biology and**	Prof. Michela A. Denti	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	Presentation of cutting-edge papers, suggested by the teacher and

	Biotechnology	(CIBIO)			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.	presented by a 30 min journal club by the student.
8.	**Stem cell Biology**	Prof. Luciano Conti (CIBIO)	12	3	The course aim is to introduce the students to the biological properties of different stem cell populations and the molecular pathways that control their stemness and developmental potency. Students will discover how stem cell biology is revolutionizing the biomedical field with its fundamental contributions to regenerative medicine and biopharmaceutical industries. Main emphasis will be on recent literature and applications.	Group discussion on assigned topic & participation.
9.	**Introduction to metagenomics**	Dr. 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)
10.	**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 and the possibility to verify some practical aspects in the laboratory. Strategies in total synthesis: linear and convergent sequence, conversion of functional groups, protective groups, carbon-carbon reactions, application of organometallic reagents; workup and isolation of the products. 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. Examples of natural product synthesis. Design and synthesis in modern drug discovery: combinatorial and biomimetic approaches. Synthesis of supra-molecular systems, also with the involvement of proteins and DNA.	Presentation and discussion of an assigned paper
11.	**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	participation and a journal article presentation

					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.	
12.	**Data Exploration**	Dr. Pietro Franceschi (Edmund Mach Foudation)	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.	Individual/Group reports and discussion on assigned topics
13.	**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
14.	**Epigenetics in Health and Disease**	Dr. Marta Biagioli (CIBIO)	12	3	What is epigenetics? The students will learn about the molecular structure of chromatin and nucleosomes packaging. They will then familiarize with the most common DNA and histone modifications, expression of chromatin-linked non-coding RNAs as well as the usage of different histone variants, evaluating their regulatory role in genomic organization, transcriptional activation, elongation	Written test with multiple-choice questions and assays

					and repression during the normal physiology of the cell and in pathological conditions such as cancer and neurological disorders	
15.	**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 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.
16	**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.
17.	**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)	

18.	**Molecular Phylogenetics and Evolution**	Dr. Omar Rota-Stabelli	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 TRACK 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 **Module 2:** From Clinical research into the market	Dr. Lucio Da Ros (ViiV Healthcare Verona) and Prof. Alessandro Provenzani (CIBIO)	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 <u>Module 2:</u> • 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**: <u>Module 1:</u> 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. <u>Module 2:</u> 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. <u>Module 3:</u> 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.	
	Module 2: The legal protection of inventions	Simonetta Vezzoso (Dept. Economics and Management)	8	2		
	Module 3: Working on a business plan	Stefano Milani (Milani & Partners, Milano)	12	3		
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	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.

					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.	

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**
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 (17 credits for mandatory/optional courses plus 3 from seminars. Attendance to a Summer School can substitute one 2-credit course)
- 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.