MANIFESTO OF STUDIES A.Y. 2016-2017

EDUCATIONAL ACTIVITIES

	1st YEAR - MANDATORY COURSES -					
	Course	**Teacher**	**Hours**	**ECTS**	**Synopsis**	**Evaluation procedure**
1.	**Laboratory Safety Course**	Prof. Mancini I. (Dept. Physics) Prof. Provenzani A. (CIBIO)	12	2	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	12	2	Procedure relative to the PhD project	Approval by the tutor

	2nd YEAR - MANDATORY COURSE-					
	Course	**Teacher**	**Hours**	**ECTS**	**Synopsis**	**Evaluation procedure**
3.	**Scientific Publishing & Communication**	Dr. Dahm R. (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**
4.	**Academic writing for Science and Engineering level I**	CLA –Centro Linguistico d'Ateneo	24	2	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.
5.	**Presentations for Science and Engineering**	CLA –Centro Linguistico d'Ateneo	16	1	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.
6.	**Academic writing for Science and Engineering level II**	CLA –Centro Linguistico d'Ateneo	24	2	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
7.	**Preclinical research and clinical development**	Prof. Borlak J. (Medical School of Hannover)	12	2	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.	Group exam of n=4 students; students are requested to prepare a 20 min presentation followed by in-class discussion;

	programs of 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.	upon request students can be examined individually.
8.	**Statistical Models**	Prof. Agostinelli C. (Dept. Mathematics)	18	3	The course aims to provide an insight on generalized linear mixed 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 the basic 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. We will also survey some of this issues that arise 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 hierarchiacal or clustered sampling), or spatial proximity of cases. Previous knowledge: Students should have basic knowledge on linear algebra, probability and statistics. Basic knowledge of unix-like operating system and LATEXwould be greatly appreciated.	
9.	**Bioinformatics**	Prof. Blanzieri E. (ICT) Prof. Passerini A. (ICT)	12	2	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.

10.	**Molecular Spectroscopic Techniques**	Prof. Guella G. (Dept. Physics)	12	2	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.
11.	**RNA Molecular Biology and Biotechnology**	Prof. Denti M. Dr. Stefani G. (CIBIO)	12	2	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, RNA interference (RNA splicing modulating therapies). The course also covers Piwi-interacting RNA (piRNA), the largest class of small non-coding RNA molecules expressed in animal cells and their role in epigenetic and post-transcriptional gene silencing of retrotransposons and other genetic elements.	Presentation of cutting-edge papers, suggested by the teacher and presented by a 30 min journal club by the student.
12.	**Stem cell Biology**	Prof. Conti L. (CIBIO)	12	2	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.
13.	**Introduction to metagenomics**	Dr. Segata N. (CIBIO)	12	2	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)
14.	**Chemical modifications and organic**	Prof. Mancini I. (Dept. Physics)	12	2	The course will focus on the core principles of synthetic strategy and methodology, with the discussion of recently published topics in the field and	Presentation and discussion of an assigned paper

	synthesis of biomolecules				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.	
15.	**Synthetic Biology**	Prof. Mansy S. (CIBIO)	12	2	The course will explore different aspects of the new field of synthetic biology. Topics ranging from top-down and bottom-up perspectives, BioBricks (parts, devices, and chassis), genetic circuits, bioengineering, minimal genomes, minimal cells, orthogonal systems, as well as combinatorial and directed evolution methods will be covered. Students will learn how synthetic biology is changing the biotechnology industry, e.g. in the pharmaceutical and biofuels industries, and how work on synthetic biology is helping to reveal how the chemical and physical complexities of a cell give rise to the emergent behavior of life.	Oral exam & participation
16.	**Advancements in understanding neuronal degeneration**	Prof. Pennuto M. (CIBIO)	12	2	The course will provide an overview of the most common neurodegenerative diseases along with the illustration of the most promising diagnostic and therapeutic approaches so far reported	Oral exam
17.	**Data Exploration**	Dr. Franceschi P. (Edmund Mach Foudation)	12	2	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
18.	**Post-translational modifications of**	Prof. Ferrari S. (University of Zurich)	12	2	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	Ongoing assessment (Journal club/Workshop) and final written exam

	proteins in the control of cellular homeostasis and cancer				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).	
19.	**Epigenetics in Health and Disease**	Dr. Biagioli M. (CIBIO)	12	2	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 and repression during the normal physiology of the cell and in pathological conditions such as cancer and neurological disorders	Written test with multiple-choice questions and assays
20.	**Cancer Models**	Dr. Marina Mione (CIBIO)	12	2	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.
21.	**Genomic and proteomic biomarkers: from target discovery to drug development applications**	Dr. Enrico Domenici (CIBIO)	12	2	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	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.

					• 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	
22	**Applied Statistics for High-Throughput Biology**	Levi Waldron (City University of New York School of Public Health, New York U.S.A.)	12	2	This course will provide biologists and bioinformaticians with practical statistical and data analysis skills to perform rigorous analysis of high-throughput biological data. 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, hypothesis testing, linear modeling, principal components analysis, unsupervised clustering, cross-validation, and bootstrap resampling methods. These are broadly useful techniques for high-throughput data and it is intended that this course will provide students with an applied statistical toolkit that is relevant across domains of biology and across genomic technologies.	Students will complete an assignment at the end of the course using "R Markdown" and its implementation in RStudio.
23.	**Introduction to the CIBIO Core Facilities**	Facility Managers (CIBIO)	6+6	2	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)	
	INDUSTRIAL TRACK					
24.	**Business Planning for biotech leaders**	Dr. Milani S. (Milani & Partners)	12	2	The course prepares PhD students to become potential leaders gaining an understanding of the fundamentals of organizational effectiveness-management finance, entrepreneurship and project management Course topics include: 1. Income statement Introduction for biotech projects 2. Balance Sheet Introduction for biotech projects 3. Free cash flow Introduction for biotech projects 4. How venture capitalists evaluate biotech projects	

					5. How to write a business plan for private/venture funding The course goes beyond the traditional debate over costs and grants as it will examine the critical processes required to develop and deliver biotech projects/products into biotech global market. The students will also work on a biotech project business plan by evaluating alternative financial/sustainability approaches.	
25.	**Strategy and Innovation management**	Prof. Nucciarelli A. (Dept. Economics)	36	6	1) Elements of Strategy 2) Business Models a - Theoretical foundations b - Key features c - Main pathways d - Business model innovation: the role of technology, managerial implications and organisational aspects 3) The platform model as a business model pathway 4) Sharing economy: competition and policy issues under the lenses The course relies on case studies. Students will be asked to join class discussions and work in groups to present a case study at the end of the term.	
26.	**Start-up Lab**	Prof. Rossi A. (Dept. Economics)	24 hours interactive lessons + 24 hours mentor ship	6	The SUL is an innovative learning experience focused on customer centric creativity, idea generation, business idea optimization and pitching finalized to develop innovative products/services which can, eventually, turn into a start-up. Students are constantly mentored by professionals and entrepreneurs.The Start-Up Lab (SUL) is a hands-on interdepartmental Lab on Innovation and Entrepreneurship (I&E). SUL learning is delivered with the blended MOOC method. I.e.: students see a 15min video before class introducing one concept. Participants will discuss such concept during the interactive lesson and will immediately apply it on their own project. 24 hours of teamwork and dedicated mentoring will complement the learning experience. http://international.unitn.it/mim/start-lab	

OTHER EDUCATIONAL ACTIVITIES					
Activity	**Description**	**year**	**ECTS/Period**	**Evaluation procedure**	**Mandatory/suggested activity**
15 Seminars	Attendance to 15 seminar per year	1st, 2nd, 3rd	2/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:

- 26 ECTS for educational activities (20 credits for mandatory/optional courses plus 6 from seminars. Attendance to a Summer School can substitute one 2-credit course)

- 154 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.