



## PhD course in Life Sciences and Biotechnology Teaching Activities 2024-2025

<b>Course:</b>	<b>BIOINFORMATICS</b>
<b>Teacher:</b>	Prof. GIANLUCA MOLLA
<b>Length:</b>	2.5 CFU (20 hours)
<b>Objective:</b>	Provide student with practical knowledge of the main bioinformatic processes used in protein investigation. All lessons will be held at the computer, in an informatics class. Most of procedures shown will be performed by the students themselves under the supervision of the teacher. Results will be discussed in a critical manner.
<b>Course Topics:</b>	<p>The course will cover the main topics of the bioinformatics approach to the study of the structure/properties of the proteins.</p> <p>In details:</p> <ol style="list-style-type: none"><li>1. The format of structural data and structural databases (PDB files, RCSB, PDBeChem, ...) and how to search and retrieve structural information;</li><li>2. Basis of visualization of 3D structures and software for macromolecule visualization (PyMol, VMD, ...);</li><li>3. Prediction of structural properties of proteins (secondary structure, transmembrane regions, signal peptides, ...);</li><li>4. Discover the evolutionary history of a protein: build a phylogenetic tree, detect the most conserved positions and predict the sequence of ancestral proteins;</li><li>5. Construction of models of the 3D structure of a protein (<i>ab initio</i> modelling, homology modelling);</li><li>6. Build models of variants <i>in vitro</i> - foldX – ProSAR (optional);</li><li>7. Prediction of binding of small ligands (e.g., drugs) to proteins by Automated Molecular Docking;</li><li>8. Prediction of quaternary structure haddock, Z-DOCK (optional);</li><li>9. Simulation of protein flexibility in solution: The Molecular Dynamics approach.</li></ol>





<b>Course:</b>	<b>BIostatISTICS</b>
<b>Teacher:</b>	Prof. GIORGIO BINELLI
<b>Length:</b>	3 CFU (24 hours)
<b>Objective:</b>	All fields of modern biology cannot be successfully approached without a knowledge of their statistical and biometrical aspects. It is thus necessary to provide the student with interlaced biological and statistical knowledge. The goal of this course is to make the students familiar with the statistical theory and terminology, so to understand the power and pitfalls of statistical analysis, with special emphasis on the planning of the experiments and the analysis of experimental data in the field of Life Sciences.
<b>Course Topics:</b>	Basics of statistical analysis: <ol style="list-style-type: none"><li>1. Why use Statistics. Populations and samples. Basics of probability. Random variables.</li><li>2. Frequency distributions; what is a statistical test: power and protection of a test, Type I and Type II errors.</li></ol> The most common statistical tests: <ol style="list-style-type: none"><li>3. Quantitative and qualitative variables – which test?</li><li>4. Some uses of the z variable.</li><li>5. The <math>\chi^2</math> test. Goodness-of-fit test and comparisons between proportions.</li><li>6. The General Linear Model (GLM)</li><li>7. Some uses of Student's t</li></ol> Other statistical tests: <ol style="list-style-type: none"><li>8. The model of Analysis of Variance (ANOVA).</li><li>9. One-Way ANOVA: the completely randomised and the randomised block designs. Two-way ANOVA.</li><li>10. Linear regression and correlation models, parameters estimate in linear, multiple and curvilinear regression.</li></ol>

<b>Course:</b>	<b>TRASVERSAL SKILLS</b>
<b>Teacher:</b>	Shared among members of the PhD course and external professionals
<b>Length:</b>	2.5 CFU (20 hours)





<b>Objective:</b>	Despite the undisputable value of specialized skills, the transversal ones represent a main key to professional success, according to some scientific studies. Transversal or soft skills pertain to cognitive, creative, managerial, relational and communication areas. Not only they represent the “most wanted” competences indicated by the corporate sector, but they are also essential life skills. Acquiring these skills provides students with the basic knowledge, abilities and qualities required to translate competences into suitable behavior for organizational purposes and for their professional evolution and success.
<b>Course Topics:</b>	The course will provide students transversal skills. The course is organized in three modules, provided in different years: <ol style="list-style-type: none"><li>1. <u>Module A – I year</u>: Information Literacy; Digital Literacy, Doctoral thesis and copyright; Open access; Collecting and processing information.</li><li>2. <u>Module B – II year</u>: Presentation skills; Problem solving; Results dissertation.</li><li>3. <u>Module C – III year</u>: Economy; Project Management; Patents &amp; trade marks; European research programs.</li></ol>

<b>Course:</b>	<b>TRENDS IN BIOMEDICAL SCIENCES</b>
<b>Teacher:</b>	Shared among members of the PhD course
<b>Length:</b>	2.5 CFU (20 hours)
<b>Objective:</b>	This course is aimed to provide advanced knowledge on the cellular and molecular bases of pathological processes, on the more recent diagnostic procedures and therapeutic intervention modes using a multi-scale approach (from the molecule to the bed of the patient). The acquired knowledge (on metabolic processes, methodologies and analytical tools) will enable students to perform physiological and pathological studies, as well as to develop novel diagnostic and therapeutic approaches.
<b>Course Topics:</b>	The course is intended to provide advanced theoretical knowledge in the continuously growing areas of biology applied to biomedical sciences and clinical research. In details: <ul style="list-style-type: none"><li>• Advanced clinical pathology;</li><li>• Advanced techniques in bioimaging;</li></ul>





	<ul style="list-style-type: none"><li>• Advanced treatments in neurodegenerative disorders;</li><li>• Biomedical engineering and biomaterials;</li><li>• Cell therapy;</li><li>• Omics in biomedical science;</li><li>• Molecular oncology;</li><li>• Vascular diseases - diagnosis, therapeutic approaches and interventions.</li></ul>
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<b>Course:</b>	<b>TRENDS IN BIOMOLECULAR SCIENCE</b>
<b>Teacher:</b>	Shared among members of the PhD course
<b>Length:</b>	2.5 CFU (20 hours)
<b>Objective:</b>	Biomolecular science is a research area that profits from a strong multidisciplinary expertise on genetics, microbiology, molecular and cell biology, structural biology, biochemistry, synthetic and systems biology, etc. This course is aimed to provide advanced and updated knowledge through a theoretical and practical training oriented to provide the required skills for supporting the students in their biotechnological research projects (in the different fields of application).
<b>Course Topics:</b>	Over the years, the course will focus on most recent trends in molecular and cell biology related to: <ul style="list-style-type: none"><li>• Analytical methods;</li><li>• Advanced cell biology;</li><li>• Advanced cell biochemistry;</li><li>• Biopharmaceuticals: from concept to production;</li><li>• Biomolecules;</li><li>• Biotransformation and biocatalysis;</li><li>• Experimental design and research methodology;</li><li>• Molecular genetics;</li><li>• Molecular microbiology;</li><li>• Molecular system biology.</li></ul>

