B2- Corso di Laurea Specialistica in Biotecnologie sanitarie

	Corso Integrato (CFU)	**Obiettivo complessivo** **Moduli di insegnamento**	**SSD (CFU)**
C1	**Biostatistica, informatica e bioinformatica applicate** **CFU 9**	Obiettivo Fornire allo studente gli strumenti teorici e applicativi per analizzare dati sperimentali ottenibili in ambito biomedico. In particolare i principali obiettivi del modulo di Biostatistica consistono nel fornire allo studente gli strumenti statistici, sotto il profilo teorico e soprattutto applicativo, utili per l'analisi di dati sperimentali e per il controllo di qualità, con particolare riferimento alle scienze biologiche. Il modulo di Bioinformatica applicata si propone di fornire allo studente la capacita' di applicare i principali strumenti bioinformatici di uso corrente in ambito biomedico. Alla fine del corso lo studente avra' la capacita' di utilizzare in maniera critica i principali strumenti di bioinformatica.Il modulo di elaborazione ed analisi di immagini si propone di formare gli studenti alla comprensione delle problematiche insite nelle procedure di acquisizione, elaborazione ed analisi delle bioimmagini digitali. Il modulo include aspetti teorici quali digitalizzazione delle immagini, rappresentazione nel calcolatore, principali operazioni di elaborazione ed analisi, compressione, e attività pratiche in aula informatica, mirate alla realizzazione di alcune semplici procedure di elaborazione ed analisi di immagini biomediche.	FIS/07 CFU 5 MED/01 CFU 2 ING/INF 05 CFU 2
		Teaching modules SSD FIS/07 MED/01 ING-INF/05	
C2	**Organ Physiopathology** **CFU 7**	Objectives Major aims of this course are two. 1. To describe the fundamental biochemical pathways that are distinctive for different organs, such as liver and heart. Concepts of tissues homeostasis and communication through metabolites and signal molecules will be also discussed. In this respect, particular attention will be devoted to the biochemical aspects of nutrition. Students will familiarize with the metabolism of skeletal muscles: energetic metabolism, aerobic and anaerobic metabolism during exercise, metabolic modifications during anoxia and ischemia. Finally, the peculiar metabolic shift occurring along with stem cells differentiation, as well as oncogenic transformation, will be also described. 2. To point out to the student the basic physical and biophysical principles underlying the function of the physiological systems, from the sub-cellular level to the whole organism and, where applicable, to condense the function itself in quantitative terms. Main contents are: functions, composition and physico-chemical properties of blood; the cardiovascular system; body fluids and renal function; the nervous system; general features about respiration, respiratory mechanisms, alveolar ventilation and gas exchange; thermoregulation; energetics, thermodynamics and mechanics of muscle contraction. During the course, practical activity related to the objectives of the course will take place.	BIO/09 CFU 2 MED/04 CFU 5
		Teaching modules SSD BIO/09 SSD MED/04	
C3	**Genetics, Epigenetics and Applied Biology** **CFU 11**	Objectives The first part of the course is mainly devoted to the presentation of problems of medical genetics that can be potentially faced by biotechnological approaches. Major technological approaches for analysis of nucleic acids are presented as well as general techniques for generation of animal models of genetic diseases. Specific issues are: general features of diseases with monofactorial and multifactorial genetic components; relevance of SNPs and CNVs evaluation in medical genetics; technological approaches to evaluate SNPs and	MED/03 CFU 5 BIO/13 CFU 6

		CNVs; morphological and molecular caryotyping; DNA sequencing; complex diseases and the problem of missing heritability; epigenetics in human diseases; animal models of genetic diseases. Then, the course focuses on introducing the student to the general and mainly innovative techniques for: i. Gene Therapy of human diseases in the field of monofactorial and hereditary phenotypes as well as of cancer: pre-clinical and clinical studies adopting viral and non viral strategies for gene transduction and tissue targeting; ii. Study of human genes/genome through Next Generation Sequencing methodologies; iii. Complex diseases and strategies for the identification of susceptibility genes: classical approaches and Genome Wide Association Studies (GWAS) potentiated by the HapMap of human genome. In each of these three field more attention is given to the study design underlying the peculiar genetic problem to be solved. Finally, the course addresses current aspects of stem cell biology and epigenetic gene regulation. The program covers key mechanisms that control pluri- and multipotency of stem cells. Central epigenetic regulatory mechanisms that include tranposons, pseudogenes, imprinting, gene silencing, X-chromosome inactivation, position effect, reprogramming, regulation of DNA and histone modifications, heterochromatin and technical limitation affecting reproductive cloning are discussed. Current advancements in understanding the role of the non-coding genome are addressed, focusing on long and small non coding RNAs. Particular focus is given on stem cell-based regenerative medicine and its great promise for repair of diseased tissue. During the course, practical activity related to the objectives of the course will take place.	
		<u>Teaching modules</u> SSD MED/03 BIO/13	
C4	**Molecular Biotechnology CFU 10**	<u>Objectives</u> Major aim of the course is to provide students with notions on basic principles and applications of the most important methodologies of molecular biotechnology with a particular emphasis to proteomics, also to the goal of designing therapeutic compounds and new diagnostic approaches. Students will have knowledge on major molecular targets to develop innovative therapeutic tools in oncology. Finally, starting from the biological problem, succesful examples of drug development in oncology will be discussed	BIO/10 CFU 5 BIO/11 CFU 5
		<u>Teaching modules:</u> SSD BIO/10 SSD BIO/11	
C5	**Embriogenesi, morfogenesi e funzioni.** **CFU 6**	<u>Obiettivo</u> Obiettivo primario del modulo è che lo studente maturi una visione unitaria dell'assetto strutturale e funzionale del corpo umano e dei fenomeni connessi con la sua formazione, l'accrescimento, il rinnovamento tissutale e l'invecchiamento. A tal fine, lo studente deve acquisire le conoscenze fondamentali sulle peculiarità e sulle dinamiche che stanno alla base dei processi differenziativi, riparativi, rigenerativi dei tessuti, sulle modalità maturative delle cellule germinali e loro prerogative biologiche e sugli eventi che guidano lo sviluppo embrio-fetale umano, compresi gli annessi embrionali. La comprensione delle suddette fenomenologie è anche finalizzata all'acquisizione delle nozioni di base indispensabili per la progettazione di biocostrutti di derivazione nativa o di neo-sintesi e nell'ideazione di sperimentazioni di ingegneria tissutale. Sulla base delle nozioni gia' acquisite nel corso della laurea triennale, lo studente deve poi acquisire una conoscenza più approfondita sulle modalità di integrazione fra tessuti costituenti specifici organi, comprese le relative correlazioni morfofunzionali, e sviluppare capacità critiche nella prefigurazione delle più adeguate tecniche di processamento e di trattamento del campione al fine di ottenere	BIO/17 CFU 5 MED/40 CFU 1

		specifici risultati sperimentali. Far comprendere i ruoli specializzati ricoperti dai principali organi; presentare l'interdipendenza del metabolismo energetico dei principali organi; presentare le prestazioni funzionali dei vari apparati e acquisire una conoscenza sull'integrazione dei tessuti nei diversi organi e le correlazioni morfofunzionali. Applicazioni biotecnologiche verranno illustrate nell'ambito della fecondazione assistita.	
		Moduli d'insegnamento SSD BIO/17 MED/40	
C6 /	**Regenerative medicine** **CFU 11**	Objectives Major aims of the course are related to stem cells and tissue engineering. The course defines and describes the major stem cell classes (i.e. pluripotent -both embryonic and induced-, fetal and adult). Common and peculiar regulatory mechanisms are described as well as the role played by stem cell niches and physical forces on stem cell biology. Furthermore, the involvement of Stem Cells in tissue turnover both in physiology and pathology are described. The principal features of tissue regeneration will be exposed, focusing on common pathways and differences between regenerating and non-regenerating organisms. As an example of the use of Stem Cells for tissue regeneration, the cardiovascular system will be described. Both experimental and clinical evidence for the exploitation of stem cells for cardiac repair will be provided. Application examples in clinical practice will be provided. During the course, practical activity related to the objectives of the course will take place.	MED/08 CFU 10 MED/18 CFU 1
		Teaching modules SSD MED/08 SSD MED/18	
C7	**Immunità e trapianti** **CFU 11**	Obiettivo Conoscenza della risposta immunitaria dell'organismo, in particolare nei confronti dei trapianti. Conoscenza dei processi di interazione fra componenti cellulari del sistema immunitario sottostante al mantenimento della tolleranza tissutale. Comprensione delle tecnologie di applicazione diagnostica e lo studio dei meccanismi patogenici dei disturbi del sistema immunitario. Per quanto riguarda l'ingegneria tissutale il corso si concentra sulle strategie per riparare, sostituire e rigenerare vari tessuti e organi per risolvere problemi clinici. Gli argomenti includono vantaggi e svantaggi dei diversi modi di costruzione di scaffolds, attualmente disponibili, e la loro applicazione. Verra' discusso come le proprieta' dei materiali influenzano la risposta cellulare e si dara' una conoscenza di base dei metodi di caratterizzazione. Si dara' anche una conoscenza della regolazione e dei problemi etici. Verranno affrontati lo sviluppo e la crescita di un tessuto, la distribuzione di farmaci, la progettazione di un bio-reattore e lo sviluppo di un prodotto. Le reazioni infiammatorie e il riparo di tessuto patologico o normale saranno discusse come modello. Verranno qui affrontati anche gli aspetti legali e sanitari legati a questi temi e piu' in generale nell'ambito biotecnologico.	MED/04 CFU 9 MED/42 CFU 1 MED/43 CFU 1
		Moduli d'insegnamento SSD MED/04 MED/42 MED/43	
C8	**Diagnosis and Therapy** **CFU 10**	Objectives The course is structured in three parts: pharmacology, internal medicine, reumathology. Course Description. The course will cover all aspects of small molecules and biologics approved, for autoimmune and cancer disease as well as novel chemotherapeutics for infectious disease, together with those that entered phase III clinical trials in the last years or are under development. This unique course will discuss the latest in new drugs	BIO/14 CFU 5 MED/09 CFU 5

		and biologics. Lectures will be delivered using traditional methods, covering new drugs; biotechnology student groups will present their projects in new drugs and biologics. Instruction materials and the reference materials will be drawn from FDA, scientific literature and drug information files. Internal medicine. The course starts providing little background for non medical students including: concept of sickness and disease, disease risk factors, evidence based medicine, the medical research. Then, several different systemic and organ diseases will be treated including: cardiovascular disease and congestive heart failure, arterial hypertension, diabetes, obesity and metabolic syndrome, renal, respiratory, endocrine and liver diseases. Reumathology. This part of the course is focused on rheumatologic diseases, defining epidemiology, etiology, pathogenic mechanisms, genetic predisposition and main laboratory and clinical features. The rheumatologic diseases are chronic inflammatory conditions characterized by hyperactivation of the immune system leading to autoimmune reactions that can determine systemic or organ-specific diseases. There are frequent (such as rheumatoid arthritis) and rare diseases (such as scleroderma and lupus), that can affect also young people leading to severe disability and reduction of life expectancy. Several immunologic defects and genetic variants have been described as significantly associated with disease susceptibility and/or severity, and many key molecules were identified as important modulators of the pathogenic process. These molecules represent the specific target of an increasing number of biotechnological drugs. During this course the most recent advances of translational research in this area will be discussed, to show the students how and where to apply the biotechnology to support clinical decisions. One of the main focus is to introduce the students to the concept of personalized medicine, through the evaluation of several examples of pharmacogenetic studies. Moreover, the important mechanisms underlying drug resistance, in particular to the biotechnological drugs, will be analysed in detail.	
		<u>Teaching modules</u> SSD BIO/14 SSD MED/09	
C9	**Specialistic disciplines CFU 10**	<u>Objectives</u> The course is structured in three parts: medical oncology, heamatology and neurodegeneration. Medical Oncology. The aim of this module is to inform students about the concepts of translational oncology and the "from bench top to bedside" concept through a series of seminar-type presentations highlighting recent advances of translational research. Students will be motivated to apply the concepts of translational oncology to their research through a series of assignments. The main theme for the course is personalized medicine, with topics on a variety of cancer types and issues ranging from cancer genetics to molecular imaging. The hematology module will focus on the recent progresses in pathophysiology of onco-hematologic diseases and on the possible role of new molecular markers as a target for innovative biotechnological drugs. Many examples of translational hematology will be discussed to explain the role of biotechnology in unraveling the basis of neoplastic transformation thus designing patient's tailored therapies. Then, effort will be dedicated to elucidate the biological and molecular basis of stem cell transplantation and post-transplant immune-related diseases, the possibility of modulation of immune response to enhance graft-versus-tumor effect and control graft-versus-host disease with the ultimate aim of short and long term survival after transplant procedure, reducing infectious complication and controlling disease recurrence. The neurodegeneration module is focused on the pathogenetic study of the neurodegenerative disorders in which the process of misfolding	MED/15 CFU 4 MED/06 CFU 1 MED/26 CFU 5

		protein is associated with neuronal death. Particularly, the aim of the course is to analyse the mechanism of misfolding protein in different pathogenetic conditions and describe the relationship of oligomers, fibrils and aggregates with human neuropathological aspects related to the principal clinical phenotypes, such as prion disorders, Alzheimer's disease, Frontotemporal lobar degeneration, Parkinson's disease and amyotrophic lateral sclerosis. In vitro and trangenic models are compared with the human neurodegenerative pathology.	
		Teaching modules SSD MED/15 SSD MED/06 SSD MED/26	
C10	**Laboratorio di Biotecnologie CFU 13**	<u>Obiettivo</u> Il corso si svolge unicamente con attivita' laboratoriale. Lo studente comincia la pratica di laboratorio sotto la supervisione del docente, in collaborazione con altri docenti del corso, svolge ricerche bibliografiche, concepisce un progetto di ricerca, sceglie un modello sperimentale e progetta il percorso per realizzarlo in laboratorio. Alla fine del periodo corrispondente ai crediti assegnati lo studente presenta il contesto e il progetto di ricerca, e le attivita' sperimentali ad una commissione che approva il lavoro dello studente.	BIO/10 CFU 13
		<u>Moduli d'insegnamento</u> BIO/10	