COURSE TITLE: Experimental Immunology

YEAR: 2nd	**TERM (SEMESTER):** 3rd

LECTURER:

Prof. Mariastefania Antica, **PhD -** Institute for Medical Research and Occupational Health, Zagreb

Prof. Maja Matulić, PhD - University of Zagreb, Faculty of Science, Department of Biology

Prof. Petra Korać, PhD - University of Zagreb, Faculty of Science, Department of Biology

Krešo Bendelja, PhD - Institute of Immunology, Zagreb

Prof. Tomislav Vladušić, PhD - University of Zagreb, Faculty of Food Technology and Biotechnology

COURSE CONTENT	**HOURS:**	**ECTS**
Lectures	12	3
Practical	5	
Tutorial	3	

COURSE OBJECTIVES: The aim of this course is to introduce the students to experimental approaches that led to the general principles of immunology in humans and animals, some key models and concepts of biotherapy in infectious, autoimmune and malignant diseases, development of new vaccine candidates, chemotherapy and immunotherapy and regenerative immunology.

COURSE CONTENT: The course will cover fundamentals of the immune system. Applicability of diverse mechanisms and principles taught us by immunology. Lymphocyte and thymus development from stem cells, and regenerative immunology, including the identification and development of adult stem cells, 3D cultures and organoid systems, hematopoietic stem cells and bone marrow transplantation, the use of flow cytometry in stem cell analysis, and applications in regenerative medicine and immune modulation. It will explore immune disorders and mucosal immunity, focusing on food allergies, autoimmune diseases, mucosal immune regulation, and the role of tumor-infiltrating immune cells in cancer. The course also addresses immune cell engineering and experimental therapies, such as novel approaches in leukemia treatment, immune cell manipulation, experimental infection models, vaccine development, and mucosal vaccine strategies. Additionally, it will examine the development and function of innate immune cells, particularly macrophages and Natural Killer (NK) cells, as well as cytokines and immune-modulating factors, including their signaling mechanisms, functional assays, and therapeutic applications.

Practical course: Imunofluorescence and flow cytometry

STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT: Regular attending the lectures, practical and seminars

MODES OF EXAMINATION: seminars and final exams

COURSE QUALITY EVALUATION: evaluation of students (final exam grades) , evaluation of lecturer (students written opinions)

RECOMMENDED LITERATURE:

Janeway's Immunobiology/ K. Murphy, C. Weaver, with acknowledgment to Charles A. Janeway, Paul Travers, Mark Walport,(eds.), 9th ed., Garland Science Publishing, 2017. https://inmunologos.wordpress.com/wp-content/uploads/2020/08/janeways-immunobiology-9th-ed_booksmedicos.org_.pdf

Original scientific papers

COURSE TITLE: Cell Culture Bioengineering

YEAR: 2nd	**TERM (SEMESTER):** 3rd

LECTURERS:

Prof. Igor Slivac, PhD - University of Zagreb, Faculty of Food Technology and Biotechnology

Prof. Kristina Radošević, PhD – University of Zagreb, Faculty of Food Technology and Biotechnology

Prof. Višnja Gaurina Srček, PhD – University of Zagreb, Faculty of Food Technology and Biotechnology

Guest lecturers:

Tanja Košutić Gulija, PhD – University of Zagreb, Centre for Research and Knowledge Transfer in Biotechnology

Maja Jagušić, PhD – University of Zagreb, Centre for Research and Knowledge Transfer in Biotechnology

COURSE CONTENT	**HOURS**	**ECTS**
Lectures	30	**4**
Practical	15	
Tutorial		

COURSE OBJECTIVES:

Identifying and addressing problems that can be resolved through the application of cell culture techniques.

Metods and principles of tissue engineering, *in vitro* drug evaluation, and viral vaccine production.

COURSE CONTENT:

Definition of cellular bioengineering

Certain aspects of cellular engineering:

- Fundamentals of Tissue engineering
- Cell migration in drug discovery
- Viral vector and viral vaccine production
- Application and cultivation of spheroids

Practical course: Cell viability assessment, monitoring morphological changes, cellular migration

STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT:

Attending lectures and practical classes. Basic knowledge in animal cell cultivation.

MODES OF EXAMINATION: written lab report, written exam

COURSE QUALITY EVALUATION: anonymous survey after the course completion

RECOMMENDED LITERATURE: review articles, references inside the teaching materials (updated regularly)

COURSE TITLE: Professional Project		
YEAR: 2nd	**TERM (SEMESTER):** 3rd	
LECTURER: **Prof. Igor Stuparević, PhD - University of Zagreb, Faculty of Food Technology and Biotechnology**		
COURSE CONTENT	**HOURS**	**ECTS**
Lectures		**2**
Practical		
Tutorial	20	

COURSE OBJECTIVES:

Development of student competences

1. how to build up your personal professional project
2. to prepare the students to find a traineeship (stay) or a job

COURSE CONTENT:

Bibliography report on the topic chosen by student for his professional practice.

Preparation of a personal professional project. Independent research and planning of a professional project. Building a professional project based on personal life experience. Defining (determining) whether “what you want” is really “what you can do”. Preparing for a job interview. Presenting and defending the central professional project in front of an audience. Understanding the organisation of a company.

Several lectures and interviews will enable the students to gather a deeper knowledge in the various careers in the "biotechnology" world, the experience real economic situation in Croatia and benefit from several professionals’ experience.

STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT: Writing a report of the meetings attended by representatives of biotech companies, job aplication, CV and letter of motivation for job aplication.

MODES OF EXAMINATION: report

COURSE QUALITY EVALUATION: anonymous course evaluation form filled by students

RECOMMENDED LITERATURE: the support given during lessons (including references inside)

COURSE TITLE: Plant Engineering

YEAR: 2nd	**TERM (SEMESTER):** 3rd

LECTURER:

Prof. Nataša Bauer, PhD - University of Zagreb, Faculty of Science, Department of Biology

COURSE CONTENT	**HOURS**	**ECTS**
Lectures	10	**4**
Practical	20	
Tutorial		

COURSE OBJECTIVES: To acquire basic knowledge in plant engineering techniques

COURSE CONTENT:

Lectures:

1. Plant micropropagation methods and conventional breeding
2. Methodology of plant genetic modification
3. Engineering plants to oovercome biotic and abiotic stress
4. Engineering plant performances and quality
5. Genome editing in plants and regulative of GMO and crops derived by new genomic techniques application

Practical work:

1. Floral dip transformation of *Arabidopsis thaliana*
2. Agroinfiltration of *Nicotiana benthamiana* leaves and detection of subcellular localization of transgenic protein(s) in the epidermal cells by fluorescent microscopy
3. Biolistic transformation of the onion epidermal cells

STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT: Regular attendance of all classes (lectures and practical)

MODES OF EXAMINATION: written exam

COURSE QUALITY EVALUATION: student evaluation and communication with students throughout the lectures and practicum

RECOMMENDED LITERATURE:

Glick, Bernard R. Molecular biotechnology: principles and applications of recombinant DNA / Bernard R. Glick, Jack J. Pasternak, and Cheryl L. Patten. - 4th ed.

Selected original scientific papers and reviews

COURSE TITLE: Bioimaging	
YEAR: 2nd	**TERM (SEMESTER):** 3rd

LECTURERS:

Prof. Josef Hamacek, PhD – University of Orléans

Asst. Prof. Anthony Delalande, PhD – University of Orléans

Sara Lacerda, PhD – CNRS Orleans Campus

Asst. Prof. Stéphane Pallu, PhD – University of Orléans

COURSE CONTENT	**HOURS**	**ECTS**
Lectures	18	**2**
Practical	0	
Tutorial	0	

COURSE OBJECTIVES:

1. Master imaging technologies in cellulo and in-vivo. Understanding the techniques of analysis for the qualitative and quantitative evaluation of cellular and living mechanisms;
2. Introduction to in vivo imaging (scope and limits);
3. Acquiring theoretical bases of data processing and applications of digital image analysis in biology. The aim is to enable insertion into technological platforms for fundamental research or medical diagnosis.

COURSE CONTENT:

Microscopy and biological applications. Fluorescence microscopy in basic and biomedical research; F-techniques (FRAP, FRET, FLIM and FCS); real-time imaging, spectral imaging, TIRF. Modern biomedical imaging: principles and applications. Optical imaging (bioluminescence, fluorescence in the visible and near infrared, optical tomography). X-ray-based imaging (radiography, computed tomography). Nuclear imaging (scintigraphy, positron emission tomography). Magnetic resonance imaging. Ultrasound imaging and hybrid methods. Molecular imaging agents combined to generate or enhance the signal.

STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT: basic knowledge of spectroscopic techniques, bases of chemistry and biochemistry

MODES OF EXAMINATION: written exam

COURSE QUALITY EVALUATION: anonymous quiz

RECOMMENDED LITERATURE: support given during lessons (including references inside)

COURSE TITLE: Chemical Analysis Techniques		
YEAR: 2nd		**TERM (SEMESTER):** 3rd
LECTURERS: **Prof. Ivone Jakaša , PhD - University of Zagreb, Faculty of Food Technology and Biotechnology** Prof. Caroline West, PhD - University of Orléans		
COURSE CONTENT	**HOURS:**	**ECTS**
Lectures	15	**2**
Practical	0	
Tutorial	0	
COURSE OBJECTIVES: Acquiring the basic knowledge of the theoretical principles of separation methods and the modern experimental approach to compound analysis in various matrices; developing the competencies necessary for scientific research and professional work		
COURSE CONTENT: The course provides an introduction to chromatography, focusing on fundamental concepts and theoretical principles underlying separation processes. Emphasis is placed on gas, liquid and thin-layer chromatography including discussions of instrumentation, operational parameters, and different detection modes. The course includes practical applications of chromatographic methods for the analysis of real samples from various matrices. Extraction methods and bioactivity testing will also be briefly addressed. Students will be introduced to the critical steps in method development, including the selection of chromatographic conditions, sample preparation strategies, and optimization of separation parameters. A portion of the course is dedicated to method validation, covering key validation parameters as defined by international regulatory guidelines.		
STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT: Regular attendance of classes.		
MODES OF EXAMINATION: Written evaluation test.		
COURSE QUALITY EVALUATION: anonymous evaluation of the course, communication with students throughout the lectures		
RECOMMENDED LITERATURE: D. A. Skoog, F. J. Holler, S. R. Crouch: Principles of Instrumental Analysis, Brooks/Cole Pub, 6th edition, 2006.		

COURSE TITLE: Innovative Therapy	
YEAR: 2nd	**TERM (SEMESTER):** 3rd

LECTURER:

Prof. Chantal Pichon, PhD - University of Orléans and Inserm

Andreja Ambriović Ristov, PhD - Ruđer Bošković Institute

COURSE CONTENT	**HOURS**	**ECTS**
Lectures	18	**3**
Practical	0	
Tutorial	0	

COURSE OBJECTIVES:

To present an overview of the different ways to modulate gene expression, especially by using nucleic acids delivery systems. Several therapeutic applications will be given. By this module we want to summarize the basic principles of gene therapy. Various gene strategies will be discussed: gene replacement, destruction of unwanted tissues, immune stimulation and tissue engineering. All stages of gene therapy will be covered: vector design, preclinical and clinical testing.

COURSE CONTENT:

The first part of the course will cover structure of viruses from which vectors are derived adenoviruses, retroviruses, adeno-associated viruses and herpes viruses. The modifications to the wild type viruses needed for a production of gene therapy vectors will be described. Special attention will be given to tumour gene therapy and vaccination. Finally, several examples of clinical trials will be given to illustrate how preclinical research is transferred into clinical testing.

The second part comprises non-viral system for nucleic acids delivery.

Applications: Cancer gene therapy and Gene therapy for monogenic diseases and regenerative medicine

STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT: Regular attendance of classes (theoretical and practical)

MODES OF EXAMINATION: written evaluation test

COURSE QUALITY EVALUATION: anonymous evaluation of the course

RECOMMENDED LITERATURE: support given during lessons (including references inside)

COURSE TITLE: Nanomedicine		
YEAR: 2nd	**TERM (SEMESTER):** 3rd	
LECTURER: **Asst. Prof. Varvara Gribova, PhD - University of Orléans**		
COURSE CONTENT	**HOURS**	**ECTS**
Lectures	14	**2**
Practical	0	
Tutorial	0	

COURSE OBJECTIVES:

The goal of this course is to familiarize the students with innovative therapeutic approaches that make use of nanomedicine, from their emergence in a research laboratory, through preclinical evaluation and up to the marketing phase.

COURSE CONTENT:

Nanomedicine encompasses several marketed products, ranging from the delivery of therapeutic molecules to medical imaging, diagnostics, and biomaterials. This course will cover different types of therapeutic approaches that utilize nanomedicine: gene therapy, targeted drug delivery, nanosystems for tissue regeneration, and more. In addition, we will present the various stages involved in the development of a therapeutic approach, such as scientific research, preclinical characterization, and the associated regulations. New technologies like molecular modelling and artificial intelligence will also be presented. By the end of this course, you will understand the "life cycle" of an innovative therapeutic approach in the field of nanomedicine, starting from its invention in the research laboratory and going through the various perilous phases of preclinical and clinical trials, before being made available to patients.

The theoretical part will be concluded by a 3-hour group work on a project, which will allow to synthetize the acquired knowledge and apply the theory.

STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT:

The students are expected to attend all the lectures and participate in the final group project.

MODES OF EXAMINATION: written exam

COURSE QUALITY EVALUATION: anonymous poll

RECOMMENDED LITERATURE: will be provided during the lectures

COURSE TITLE: Chemical Analysis Techniques - practical training		
YEAR: 2nd	**TERM (SEMESTER):** 3rd	
LECTURERS: **Prof. Caroline West, PhD - University of Orléans** Prof. Ivone Jakaša, PhD - University of Zagreb, Faculty of Food Technology and Biotechnology		
COURSE CONTENT	**HOURS:**	**ECTS**
Lectures	0	**2**
Practical	12	
Tutorial	0	
COURSE OBJECTIVES: Understand the basics of instrumental analysis with particular focus on chromatographic and electrophoretic separation methods. Learn how to prepare samples of natural products prior to introduction in the separation systems.		
COURSE CONTENT: This laboratory-based course provides hands-on experience with modern instrumental methods of chemical analysis, with a primary focus on chromatographic techniques. Students will learn the principles, operation, and applications of gas chromatography (GC), high-performance liquid chromatography (HPLC), and related separation methods. Through practical exercises, they will develop skills on method development for the analysis of natural products from sample preparation, instrument calibration and method optimization to data interpretation.		
STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT: Regular attendance of classes.		
MODES OF EXAMINATION: Evaluation of written reports submitted after practical works.		
COURSE QUALITY EVALUATION: anonymous evaluation of the course, communication with students throughout the lectures		
RECOMMENDED LITERATURE: D. A. Skoog, F. J. Holler, S. R. Crouch: Principles of Instrumental Analysis, Brooks/Cole Pub, 6th edition, 2006.		

COURSE TITLE: Gene Therapies Practical Training		
YEAR: 2nd	**TERM (SEMESTER):** 3rd	
LECTURERS: **Prof. Maryvonne Ardourel, PhD – University of Orléans** Asst. Prof. Anthony Delalande, PhD – University of Orléans		
COURSE CONTENT	**HOURS**	**ECTS**
Lectures	0	**2**
Practical	20	
Tutorial	6	

COURSE OBJECTIVES: The objectives of the course are to provide students with a practical understanding of gene therapy strategies, tools, and experimental techniques. The course aims to illustrate how gene therapy can be used to correct genetic disorders or modulate gene expression, through hands-on sessions involving nucleic acid manipulation, transfection, and analysis of gene expression. Students will be expected to progressively acquire autonomy and critical thinking by simulating conditions encountered in a real research laboratory environment.

COURSE CONTENT:

Introduction to gene therapy: principles, vectors, and delivery systems; RNA extraction and quantification techniques; Use of plasmids vectors; Transfection methods in mammalian cells (lipofection, electroporation); Assessment of gene expression by RT-qPCR and reporter gene assays; Microscopy techniques for cell imaging and transfection analysis; Flow cytometry for quantitative analysis of transgene expression and cell populations; Safety procedures in a lab; Applications in neurology, oncology or rare diseases (depending on the project); Applications of the "Innovative Therapies" course (C. Pichon) in practical settings

STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT: Regular attendance of classes (theoretical and practical)

Regular attendance of both theoretical and practical sessions is mandatory. Students are expected to actively participate in all laboratory activities, comply with safety and hygiene regulations, and demonstrate responsible conduct in a research environment.

During the week of practical training, students will work in groups to design and carry out a coherent series of experiments under semi-autonomous conditions, simulating the workflow of an academic research project.

Each group will be required to compile all data and analyses into a final report written in the format of a scientific article, which will be assessed for scientific rigor, clarity, and collaboration quality.

MODES OF EXAMINATION:

Scientific report: a structured manuscript in the format of a scientific article compiling the results of the practical week. The report will be evaluated for scientific accuracy, methodological clarity, data analysis, and group collaboration.

Participation grade: individual evaluation based on active engagement, autonomy, teamwork, and respect of laboratory safety and hygiene rules during the practical sessions.

COURSE QUALITY EVALUATION: anonymous evaluation of the course

RECOMMENDED LITERATURE: will be provided during the practical work

COURSE TITLE: Scientific Communication in English and in French		
YEAR: 2nd	**TERM (SEMESTER):** 3rd	
LECTURERS: **Prof. Ana Kovačić - University of Zagreb Faculty of Food Technology and Biotechnology** **Prof. Marie Delmet - Embassy of France in Croatia**		
COURSE CONTENT	**HOURS**	**ECTS**
Lectures	30	
Practical		
Tutorial		
COURSE OBJECTIVES: The aim of this course is to provide French and Croatian students with a knowledge of scientific English and Croatian students with a basic knowledge of French and to introduce specific terminology, both colloquial and scientific.		
COURSE CONTENT:		
STUDENT REQUIREMENTS IN THE COURSE AND THE WAY OF ACCOMPLISMENT: none		
MODES OF EXAMINATION: written exam		
COURSE QUALITY EVALUATION: anonymous evaluation of the course		
RECOMMENDED LITERATURE: will be provided during the lectures		