NAME OF THE COURSE	Molecular Cell Biology					
Code	PMB701	Year of study	1.			
Course teacher	Ivana Novak Nakir, Ph.D, Associate Professor Ivica Šamanić, Ph.D., Assistant Professor Katarina Trajković, Ph.D, Research Assistant	Credits (ECTS)	8			
Associate teachers	Mija Marinković, Ph.D	Type of instruction (number of hours)	L	S	E	F
			45	15	45	
Status of the course	Obligatory	Percentage of application of e-learning	10%			

COURSE DESCRIPTION	
Course objectives	Understanding of the basic cell structures and regulatory cell biology mechanisms on a molecular level. Students will be introduced to current molecular and cellular biology research procedures in a hands-on environment. This course develops technical skills and prepare students for a career in science or research work.
Course enrolment requirements and entry competences required for the course	Recommended fundamental knowledge of cell biology, genetics, biochemistry and molecular biology.
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	After successful completion of this course students will be able to: • links the structure and function of the cellular organelles to the mechanisms that modulate cellular response to external or internal stimuli • use equipment and reagents properly, maintaining a safe laboratory environment • discuss research results in the context of the scientific literature through written and oral communications • describe and carry out basic cell culture and microscopy • write a lab report that includes an evaluation of the results obtained in the laboratory • present research in a seminar form • work cooperatively in a molecular biology lab
Course content broken down in detail by weekly class schedule (syllabus)	LECTURES: INTRODUCTION-Structural and functional organization of cells, The chemical components of a cell NUCLEAR STRUCTURE AND DYNAMICS - Nuclear matrix or nuclear skeleton, Nuclear Bodies (nucleolus - RNA Synthetic Apparatus, Cajal bodies, promyelocytic leukemia nuclear bodies, PML-NBs), nuclear transport (mRNA transport), Chromatin structure and function FUNDAMENTAL MOLECULAR GENETIC MECHANISMS – From DNA to protein (the Central dogma), The ribosome (the ribosome is a Ribozyme), Regulated synthesis and degradation of proteins (ubiquitin and proteasome – mediated proteolysis) THE CELL CYCLE - S phase, Mitosis and Cytokinesis, Control of the Cell Cycle: The Role of Protein Kinases (regulation of CDK activity), Checkpoints, Cdk Inhibitors; Genetic Control of Meiosis, Deregulation of the Cell cycle

	THE STRUCTURE AND FUNCTION OF THE PLASMA MEMBRANE – The Lipid Bilayer: Composition and Structural Organisation; Membrane Proteins: Structure and Basic Functions CYTOPLASMATIC MEMBRANE SYSTEMS – The Endoplasmatic Reticulum, The Golgi complex, Types of Vesicle Transport, Moving Proteins into Membranes and Organelles, Glycosylation, Vesicular Traffic, Secretion, and Endocytosis, Autophagy CELLULAR BIOENERGETICS AND METABOLISM – Catalysis and the energy consumption (oxidation and reduction, carrier molecules – ATP, NADH and NADPH), The structure and functions of Mitochondria (ATP production in mitochondria), Chloroplast and photosynthesis (molecular analysis of photosystems) INTERACTION BETWEEN CELLS AND THEIR ENVIRONMENT - Cell Junctions, Cell Adhesion (Cell adhesion molecules - transmembrane proteins), and the Extracellular Matrix (Proteoglycans, Fibrous proteins - collagen and elastin) THE CYTOSKELETON AND CELL MOTILITY- Structure and Function of Microtubules, Intermediate Filaments, Actin, Myosin, Cellular Motility CELLULAR RESPONSES TO DNA DAMAGE – DNA damage detection and signaling (Protein-Tyrosine Phosphorylation as a Mechanism for Signal Transduction), Transcriptional Response (Post-transcriptional gene control), DNA Damage Checkpoints, DNA Repair Mechanisms, Apoptosis (Programmed Cell Death) and non-apoptotic types of cell death (necroptosis, pyroptosis, anoikis, mitotic catastrophe) CELL SIGNALING AND SIGNAL TRANSDUCTION – The Basic Elements of Cell Signaling, Signal Transduction by G Protein-coupled receptors, The Ras-Map Kinase Pathway, Signaling by the Insulin Receptor, The roles of Calcium and NO as an Intracellular Messengers, Cytokine receptors and the JAK/STAT signaling pathway, Signaling pathways: Wnt and Notch, Hedgehog and NF-κB, BIOLOGY OF SPECIFIC CELL TYPES AND CELL DIFFERENTIATION – Cell reprogramming and pluripotent stem cells, Nerve cells (neurons), Immune cells (Natural killer cells, B-cels, T-cells), Adipose tissue (adipocytes), Cell memory, Mechanisms of cell polarity and asymmetric cell division, Cancer cells. LABORATORY: Students will spend 4h at MedILS, where they will be introduced to laboratory work related to cell biology – cell culture room, main laboratory, microscopes. Samples containing cells with fluorescently labeled organelles will be observed under the fluorescent microscope. At the end, students will write a laboratory report which will be evaluated by the lecturer. Experimental Topic. - microscopy methods for structural analysis of the eukaryotic cell - cultivation of eukaryotic cells - organelle isolation - cell cycle analysis by quantitation of DNA content with flow cytometry - analysis of cell viability using Propidium Iodide - DNA damage sensitivity - In vitro non-homologous DNA end joining assays - Spatio-temporal dynamics of protein assembly/disassembly at sites of DNA breaks - expression and localization of a fusion protein of a targeted gene and a reporter gene - monitoring of autophagy by fluorescent labeling of autophagosomal vesicles

	- Isolation and purification of receptor proteins by affinity chromatography - Co-Immunoprecipitation: Isolation of protein signaling complexes from native tissues SEMINARS: Reading and discussing primary scientific literature, writing a short assay summarizing analyzed articles. Selected articles related to the above topics will be analyzed in 2-hour blocks. Assays will be written at home and submitted to the lecturer for evaluation.

Format of instruction	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *on line* in entirety ☒ partial e-learning ☐ field work	☒ independent assignments ☒ multimedia ☒ laboratory ☒ work with mentor ☐ (other)
Student responsibilities	Attendance at all lectures is strongly recommended. Students are required to attend laboratory exercises and write lab reports.	

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1	Research		Practical training	1
	Experimental work		Report		Lab reports	1
	Essay		Seminar essay	1	Quizzes	1
	Tests		Oral exam		(Other)	
	Written exam	3	Project		(Other)	

Grading and evaluating student work in class and at the final exam	Methods of Evaluation • Lab reports All lab reports must contain complete and detailed outline of the experimental procedure, description of the results accompanied by analysis and interpretation. • Quizzes Quizzes will cover both material from the previous labs as well as material on the experiment for the present lab session (based on theory and protocols found in the lab manual and interpretation of data) • Practical skills At times, students will be asked to demonstrate techniques of accurate preparation of chemical solution and reagents, correct assembly of reactions according to protocol, ability to pipette correctly, competent use of standard and specialized equipment and sterile technique. • Research-based class seminar will be elevated. Students will have to prepare presentation showing background of the problem they are dealing with. The presentation will be scored according to the content of the presentation (key words, critical review of literature, presentation of scientific results), format, innovativeness and language competence as well. • Class Participation will also be part of the grade. • Final Lecture Exam: written examination. Final grades will be based on each student's performance as assessed by points total.

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	1. Lodish, Harvey - Molecular cell biology		

	8th edition.: New York, NY: W. H. Freeman, 2016.		
Optional literature (at the time of submission of study programme proposal)	Gerald Karp, Janet Iwasa, Wallace Marshall - Karp's Cell and Molecular Biology- Wiley E-Text, 2016 Lab Manual: Lab exercises will be provided in the form of handouts.		
Quality assurance methods that ensure the acquisition of exit competences	Student evaluation		
Other (as the proposer wishes to add)			