NAME OF THE COURSE	Molecular Genetics					
Code	PMP246	Year of study	1			
Course teacher	PhD Jasna Puizina; Full Professor	Credits (ECTS)	7			
Associate teachers	PhD, Ivica Šamanić, Assistant Professor	Type of instruction (number of hours)	L	S	E	F
			24	12	30	
Status of the course	mandatory	Percentage of application of e-learning	10			

COURSE DESCRIPTION	
Course objectives	Students will gain insights into the structure, organization, and function of genetic material as well on mechanisms of transmission and regulation of genetic information. They will also get acquainted with the most important achievements of applied genetics.
Course enrolment requirements and entry competences required for the course	Passed or enrolled subject Molecular Biology.
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	After passing the exam in Molecular Genetics, the student will be able to: 1. Demonstrate knowledge of the structure and organization of genetic information in prokaryotes and eukaryote. 2. Demonstrate knowledge of key molecular mechanisms of transmission, expression and control of genetic information. 3. Use basic online tools and databases. 4. Independently design smaller experiments with DNA, RNA and proteins. 5. Apply simpler molecular techniques, interpret the results obtained. 6. Use scientific literature. 7. Possess the skill of oral presentation of one's own or other results, writing reports.
Course content broken down in detail by weekly class schedule (syllabus)	Lectures 1. Molecular and cellular basis of inheritance (2 hours). Learning Outcomes: Understanding of the structure and function of genes, DNA, chromosomes. Interpreting molecular and cellular basis of inheritance. To be able to explain Mendel's 1st and 2nd law of inheritance, and to apply it in practice. 2. Basic models of inheritance (2 hours) Learning outcomes: Knowing of the basic models of inheritance: autosomal dominant and recessive, X-linked dominant and recessive, Y-linked, pseudoautosomal, cytoplasmic and polygenic inheritance. Knowing the models and the molecular basis of inheritance of the most common congenital diseases in humans. To be able calculate the probability of occurrence of some hereditary trait (disease), based on family data (pedigree analysis). Knowing how to use the OMIM database (Online Mendelian Inheritance in Man) http://www.ncbi.nlm.nih.gov/omim/ i other online databases. 3. Interactions between alleles and genes. (2 hours) Learning Outcomes: Knowing molecular basis of interactions between alleles of one gene (incomplete dominance, codominance, lethal alleles, multiple alleles), and interactions between alleles of different genes (epistasis, pleiotropy, complementary genes, duplicate genes). 4. Human genome project. (2 hours) Learning outcomes: Knowing the main characteristics structures of the human genome and understanding the main sources of genetic diversity among people. Distinguishing single nucleotide polymorphisms (SNPs) and mutations. Distinguishing between rare hereditary diseases and predisposition (predisposition) to the development of the disease.

	5. Genetics of sex. (2 hours) Learning outcomes: Knowing the chromosomal and molecular basis of the sex determination in humans. Knowing Lyon's Dose Compensation and specifics of the molecular structure of sex chromosomes (X and Y). Being able to interpret causes of sex development disorders. 6. Linked genes. Cytogenetics (2 hours) Learning outcomes: Distinguish complete and partial linkage of the genes, understanding the concept of haplotype. Knowing how to calculate the distance between genes and basics of chromosome mapping. Knowing the application of linked genes in medical genetics (Linkage analysis). Knowing the working principle of the fundamental cytogenetic methods (preparation of human chromosome preparations, chromosome banding techniques, fluorescent *in situ* hybridization, comparative genomic hybridization) and their application in medicine and biology. 7. Chromosomal mutations (1 hour) Learning outcomes: Knowing the mechanism of origin and consequences of the most common human chromosomal disorders. 8. Eukaryotic genome organization. (1 + 2 hours) Learning outcomes: Knowing different genetic elements of the eukaryotic genome: unique functional sequences, repeating and intergenic sequences. Interpreting the application of VNTR sequences in forensics (micro- and minisatellites). Knowing the different types of mobile genetic elements (transposons and retrotransposons), molecular mechanisms of their movement and their importance in disease onset and genome evolution. Explain the paradox of C values. 9. Epigenetics and regulation of genetic activity. (2 hours) Learning outcomes: Interpreting association of chromatin structure and transcription. Explaining the basic molecular mechanisms of epigenetics: DNA methylation, covalent histone modifications (histone code), RNA interference. Knowing the practical aspects of epigenetics in humans: differences between identical twins, genomic imprinting and related diseases, the influence of some nutrients on the genome and transcriptome. 10. Stem cell technology and gene therapy. (2 hours) Learning outcomes: Knowing the definition and types of stem cells, possibilities of their application in medicine and biology. Understanding the principles and techniques of gene therapy, identifying risks and benefits, be aware of some ethical dilemmas. 11. Targeted gene correction and immunogenetics (2 hours): Understanding of the latest methods of the gene correction by using CRISPR-CAS9 systems and application possibilities. Understanding basic concept of immune system and genetic determination of antibody and T receptor production. Knowing the principle of production of monoclonal antibodies and some of their most important applications. 12. Cancer genetics (2 hours) Learning outcomes: Knowing the basic differences between cancer and normal cells. Distinguishing main mechanisms of cancer development. Knowing the significance of tumor viruses, oncogenes, tumor-suppressor genes and DNA repair genes in the onset of cancer. Knowing some molecular approaches to cancer treatment. Seminars: Each student makes two seminars, writes them in the form of a word document and PowerPoint presentations, presents in front of colleagues and answers the questions: The first seminar is a processing and interpretation of one of the chapters from the textbook (6 hours). The second seminar is a processing and interpretation of an original or reviewed scientific article (6 hours) Exercises:

	1. Cellular and molecular basis of inheritance. (4 hours) Learning outcomes: Highlighting the main characteristics of mitosis and meiosis. Showing by drawing (scheme) their different stages and solve tasks from the same issue. Showing the cell cycle, highlighting the main stages. Showing understanding of structures and functions of DNA, RNA and protein by solving different problems and tasks. 2. Basic models of inheritance and Mendel's 1st and 2nd law of inheritance. (4 hours) Learning outcomes: Making a simple family tree, calculating the probability of occurrence hereditary diseases depending on the model of inheritance. Determining blood type (ABO system and Rh factor) using a blood group (antibody) kit. 3. Mechanisms of sex determination. (2 hours) Learning outcomes: Make a smear preparation epithelial cells of the buccal mucosa, microscopically identify X-chromatin, Barr-body. 4. Human karyotype and chromosome changes (4 hours) Learning outcomes: Making human karyotype (identification of homologous pairs and basic groups of chromosomes). Distinguishing normal karyotype from abnormal. Interpretation of application examples FISH techniques. 5. Basic elements of practical bioinformatics (4 hours) PubMed, OMIM, blast, analysis and aligning selected DNA sequences, and making primers for PCR. Learning outcomes: Independent use online tools, independently design smaller experiments with DNA and RNA molecules. 6. Isolation of eukaryotic genomic DNA and bacterial plasmid DNA (4 hours) Learning outcomes: Independently isolate DNA (eukaryotic and prokaryotic), understand procedures, principles of technique, chemicals and devices and use them independently. 7. Digestion of DNA (genomic and plasmid) by restriction endonucleases, DNA electrophoresis (4 hours) Learning outcomes: Understanding the function and application of restriction endonucleases and vectors - basic tools of genetic engineering (recombinant DNA technology). Solving simpler tasks in this area. Using independently chemicals, devices, prepare an agarose gel and perform nucleic acid electrophoresis. 8. Identification of perpetrators of crime by analysis of DNA samples. (4 hours) Learning outcomes: Understand and independently perform PCR technique and gel electrophoresis. Understand the application short repetitive sequences (STR) of a man in forensics. Perform an identification exercise of the perpetrator of crime using a commercially available genotyping kit with a required components (DNA samples, PCR master mix, appropriate marker).
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	Students are required to attend at least 70% of lectures, 80% of seminars and all exercises. At the exercises, students must have a notebook where they record the results of the exercises. The notebook is eventually reviewed and must be positively graded. Students need to pass two colloquia during lectures and a colloquium from exercises. They are obliged to prepare at least two seminars on selected topics, and present it to the teacher and their colleagues.

Screening student work *(name the proportion of ECTS credits for each*						
	Class attendance	3	Research		Practical training	
	Experimental work	1	Report		(Other)	

activity so that the total number of ECTS credits is equal to the ECTS value of the course)	Essay		Seminar essay	1	(Other)	
	Tests		Oral exam		(Other)	
	Written exam	2	Project		(Other)	

Grading and evaluating student work in class and at the final exam	Out of a total of 100 points, 70 points can be obtained for two colloquia from a lecture (orcomplete exam from the same material), 15 points for practicum and 15 points for seminar. Final grade: 90 - 100 points: grade 5 (excellent) 78 - 89 points: grade 4 (very good) 66 - 77 points: grade 3 (good) 55 - 65 points: grade 2 (sufficient) <55 points grade 1 (insufficient). 3 extra points for attending all lectures or with one absence

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	[1] Pavlica M, Online Textbook from Genetics http://www.genetika.biol.pmf.unizg.hr	-	yes
	[2] Cooper, G.M. 2018: The Cell a Molecular Approach, Sinauer Associates, Oxford University Press; 8th Edition, 2018).	5	yes
	[3] Puizina J, 2016: Molecular genetics, Web teaching materials.	-	yes
	[4] Tamarin, R.H: Principles of Genetics. 6th ed. WCB, McGraw-Hill, 1999. Lewis, R: 2005	2	yes

Optional literature (at the time of submission of study programme proposal)	[1] Lewin, B., Genes VIII. 8th edition. Pearson Prentice Hall, Pearson Education, 2004.
Quality assurance methods that ensure the acquisition of exit competences	Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.
Other (as the proposer wishes to add)	-