LABORATORY TECHNOLOGIES IN MOLECULAR GENETICS AND BIOLOGY	
GENERAL INFORMATION	
Course teacher	Assoc. Prof. Jasenka Wagner, MMedBiochem, PhD
Associates	Prof. Marija Heffer, MD, PhD Asst. Prof. Vedrana Ivić, MEd Biol at Chem, PhD Marta Balog, MEng Biology, PhD
Study programme	Graduate University Study of Medical Laboratory Diagnostics
Course status	Elective
Year of study, semester	1st year, 2nd semester
ECTS credits	**5**
Form of teaching (number of classes)	Lectures: 35; Seminars: 20; Exercises: 15
Expected number of students attending the course	20
COURSE DESCRIPTION	
Course objectives	
To present to the students contemporary discoveries in molecular biology, genetics and genetic engineering, with emphasis on practical use of such discoveries in research and diagnostic laboratory.	
Course entry requirements and competencies needed for the course	
Completed courses at the Undergraduate Study Programme of Medical Laboratory Diagnostics or equivalent bachelor's degree (baccalaureate)	
Learning outcomes at study programme level	
1.1, 1.2, 2.1, 2.2, 2.3,2.4, 2.6, 3.1, 3.2	
Expected learning outcomes at course level	
After attending lectures, seminars, laboratory exercises, independent study and passing the exam, students will be able to: 1. use different enzymes in molecular biology and perform DNA cleavage by means of restriction endonuclease 2. use methods of nucleic acid amplification (PCR, rtPCR, RT-PCR, dPCR), electrophoretic separation methods and hybridisation techniques 3. apply cytogenetic techniques, microdissection 4. apply methods of prenatal diagnostics, assisted reproduction 5. interpret laboratory results (in the field of molecular genetics, molecular cytogenetics, cytogenetics) 6. asess measuring techniques for different biological indicators of biological effects of radiation and chemicals 7. apply methods used in oncogenetic diagnostics 8. organise activities in a laboratory for molecular biology and genetics in accordance with the rules of profession 9. Independently and critically interpret scientific literature in the field of medical genetics, and search through online genetic databases	
Course content	
Lectures: Gene, chromosome and genome mutations: mechanism of spontaneous and induced mutations; physical, chemical and biological mutagens, mutation repair mechanisms, numerical and structural aberrations, chromosomal syndromes. Types of inheritance: Mendelian (autosomal and sex-linked) and non-Mendelian inheritance (mitochondrial, uniparental disomy, phenomenon of genomic imprinting, dynamic mutations and mosaicism); polygenic and multifactorial inheritance.	

Molecular biology techniques: restriction endonuclease and vectors; cDNA and DNA libraries, hybridization probes, Southern and Northern blot, sequencing, restriction fragment length polymorphism (RFLP), polymerase chain reaction (PCR), DNA microchips. Cytogenetic techniques: techniques of classical (G, R and C-banding for chromosome identification) and molecular cytogenetics (FISH, mFISH, CGH, PRINS, microdissection and reverse chromosome painting). Oncogenetics: genetic basis of malignant transformation, proto-oncogenes and their activation mechanisms, tumour suppressor genes, disorders of cellular cycle control, tumorigenesis. Population genetics: population balance characteristics, Hardy–Weinberg principle, factors influencing gene balance, gene polymorphism and significance of population genetics research in medicine. Epigenetics. Pharmacogenetics. 'Smart drugs'. Biological therapy. Development of mRNA vaccines.
Prenatal diagnostics: Invasive methods (biopsy of chorion frondosum, amniocentesis, cordocentesis) and non-invasive methods (ultrasound and biochemical screening), preimplantatation genetic diagnostics. Genetic counselling: making a clinical diagnosis, diagnostic method selection, risk calculating, providing information on genetics in accordance with basic ethical principles and methods of genetic counselling. Specific issues in genetic counselling (non-penetrance of genes, variable expression, phenocopies, genetic heterogeneity, consanguinity, false paternity).
Developmental genetics: gametogenesis, fertilization, early embryonic development, sex determination, growth and differentiation, differential activity of genes, differentiation of teratogenic and inherited factors, methods of assisted reproduction, stem cells and cloning.

Seminars: Evolution of sex chromosomes. Cultivation of 3D cell cultures. Cultivation of functional tissues for transplantation. Ethics and legal regulations in human genetics. Biomonitoring of persons exposed to ionizing radiation and carcinogenic chemicals. Nanocarriers for drug delivery. Inhalation vaccines. Free DNA – a new biomarker in medicine? Modern DNA sequencing techniques. Micro-chimerism. Liquid biopsy.

Exercises: Cell membrane isolation by ultracentrifugation. Isolation of lipids from cell culture and HPTLC. SDS-PAGE and electrophoresis. Western blot I. Western blot II and slot-blot. Stem cells and cloning.

Forms of teaching

Lectures; seminars; laboratory exercises.

Students' responsibilities

Attendance is obligatory throughout all course forms, and the student has to attend all the exams. Student absence of up to 30% is considered acceptable in each teaching form. Practical work and seminars that were not completed have to be taken in the form of colloquiums. The student has to attend all forms of exams required.

Monitoring students' work *(Connecting learning outcomes, teaching methods and evaluation)*

Teaching activity	ECTS	Learning outcome	Student activity	Evaluation methods	Grade points	
					Min.	Max.
Attending classes Lectures	0.25	1-9	Attendance	Attendance records	2	5
Seminars	0.5		Active participation in seminars	Seminar paper	2	16
Essay	0.5				5	7.5

Lab. exercises	0.25		Essay writing and presentation Practical work	Essay handed in Study report handed in	1	3.5
Final exam	3.5	1-9	Studying for final exam	Written exam	20	34
				Oral exam	20	34
Total	**5**				**50**	**100**

Evaluation of written part of final exam

Percentage of correct answers (%)	**Grade points**
60.00-64.99	20
65.00-69.99	22
70.00-74.99	24
75.00-79.99	26
80.00-84.99	28
85.00-89.99	30
90.00-94.99	32
95.00-100.00	34

Formulating the final grade:
Grade points achieved in classes are combined with points achieved in the final exam. Grading in the ECTS system is absolute grading and represents one's final achievement. Grades are numerically expressed as follows: A – excellent (5): 80-100 grade points; B – very good (4): 70-79.99 grade points; C – good (3): 60-69.99 grade points; D – sufficient (2): 50-59.99 grade point

Assigned reading (available in the library and in other media)

Title	Number of copies in the library	Availability in other media
Turnpenny PT and Ellard S: Emeryeve osnove medicinske genetike, 14th edition, Medicinska naklada, Zagreb, 2011	11	
Nives Pećina-Šlaus et al. Odabrane metode molekularne biologije, Medicinska naklada, Zagreb, 2009	12	
Sertić J et al. Klinička kemija i molekularna dijagnostika, Medicinska naklada, Zagreb, 2008	5	
Cox TM and Sinclair J: Molekularna biologija u medicini, Medicinska naklada, Zagreb, 2000	10	
Recent scientific articles recommended by the teacher		Yes. On line

Further reading

1. Patrinos, G.P., Ansorge, W. Molecular Diagnostics., Elsevier Academic Press, 2005
2. Metode u molekularnoj biologiji Ambriović Ristov A. et al. Metode u molekularnoj biologiji, Zagreb, Institut Ruđer Bošković, 2007 (manual)
3. Griffiths AJF et al. An Introduction to Genetic Analysis, 8/e, WH Freeman & Co., 2005

Quality assurance methods that ensure the acquisition of exit competencies

Anonymous, quantitative, standardised students' opinion survey on the course and teacher's work, carried out by the Quality Assurance Office of the Faculty of Medicine in Osijek.