COURSE UNIT (MODULE) DESCRIPTION –PLANT MOLECULAR BIOLOGY

Course unit (module) title	Code
PLANT MOLECULAR BIOLOGY	

Lecturer(s)	Department(s) where the course unit (module) is delivered
Coordinator: Prof. Irutė MEŠKIENĖ	Faculty of Natural Sciences, Department of Biochemistry and Molecular biology

Study cycle	Type of the course unit (module)
Second	Elective

Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction
Face to face	1st semester, autumn	Lithuanian (English)

Requirements for students	
Prerequisites: Organic chemistry, biochemistry, molecular biology	**Additional requirements (if any):**

Course (module) volume in credits	Student's total workload	Contact hours		Self-study hours
5	133	Lectures	32	69
		Seminars	16	
		Laboratory work	16	

Programme competences to be developed

Upon the successful completion of this course, students will acquire:

Subject-specific competences:

- In depth knowledge of the structural and functional features of plant cell at the molecular level;
- knowledge on the modern problems of plant molecular biology and biotechnology;
- knowledge on the modern methods of plant molecular biology and biotechnology;
- skills to select appropriate methods of plant molecular biology in research and to interpret reasonably the results obtained through application of these methods;
- skills to analytically, critically and systemically study, analyze and evaluate information related to the plant molecular biology and biotechnology and their application;
- skills to apply theoretical and practical knowledge in independent scientific research;

General competences:

- skills to perform research and practical work requiring analytical and innovative thinking;
- skills to improve and update knowledge and skills and to seek new ones;
- skills to present in written and verbal forms the knowledge and concepts of the plant molecular biology;

Learning outcomes of the course unit (module)	Teaching and learning methods	Assessment
• Describes the structure and functions of plant cells at the molecular level; • Describes the modern methods of plant genetic engineering, genome analysis, plant biotechnology, plant molecular biology and their current problematic; • Is able to plan simple experiments in plant molecular biology/biotechnology, to formulate the aims, questions and	Lectures, seminars, laboratory works, self-study	Midterm exam, Seminar presentation, Exam

tasks; • Is capable of performing simple experiments to study plant gene expression analysis on cellular, tissue and whole plant level; genomic studies; • Analytically, critically and systemically evaluates the scientific informationin the plant molecular biology and biotechnology and its application.		

Content: breakdown of the topics	Contact hours							Self-study work: time and assignments	
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work placement	**Contact hours**	**Self-study hours**	**Assignments**
1. Plant genomes and genes. Features of plant genes and genomes, their size, structure, non coding sequences, reteting elements, syntheny; functional annotations of model plant genomes; plant specific genes; chloroplast and mitochondrial genomes, endosymbiotic theory. Biotechnological applications of model plant genome sequencing data; genomic libraries and vectors, cloning of plant genes.	**4**						**4**	**6**	Analysis of the topic-related scientific papers and material presented by teacher; self-directed learning; preparation of the seminar when topic is selected
2. Plant gene expression -transcriptome. Cloning of coding sequences, plant specific vectors, methods to study gene expression, plant mRNA; cDNA libraries, plant gene families. Regulatory sequences, promoters, enhancers, conserved sequences, introns, alternative splicing. Factors affecting gene expression: TF and their identification, mRNA stability, role of the chromatin structure, translational control.	**4**						**4**	**6**	The same
3. DNA transfer to plant cells. Plant objects for transformation; *in vitro* cultivation methods; media, plant hormones, callus, suspension, meristem, embryo, microspore and root cultures, isolated protoplasts; plant regeneration *in vitro*, somatic embryogenesis and plant cell totipotency.	**5**						**5**	**7**	The same
4. Plant transformation. Methods and vectors for plant transformation, analysis of their elements and specific applications: constitutive, regulated and tissue specific promoters, selection markers, co-integrative and binary vectors. Features of transgenes, transgene integration, "clean gene" technologies.	**5**						**5**	**7**	The same
5. Modification of plants by transformation. Various technologies and their	**5**						**5**	**6**	The same

applications:biotistic, protoplast, Agrobacterium-mediated transient and stable transformations. Ti plasmid, its transfer and integration processes in plants. Application of transgenic strategies: protein production and plant resistance to environment.									
6.New technologies in plant molecular biology. Functional genomics, reverse genetics, tilling, RNAi, TGS and PTGS, silencing, applications in biotechnolgy. Methods of analysis: in situ hybridisation, enhancer traps, Norther, microchips. Cultivation of plants cells and organs *in vitro.* Plant protein studies, protein interaction, localization, proteomics.	**4**						**4**	**5**	The same
7. Signal transduction in plant cells. Recepors, receptor like kinases, Ca2+ signaling, signaling by protein kinases, reversible protein phosphorylation, protein phosphatases; signaling pathways during plant development and in response to stress. Plant environmental responses.	**5**						**5**	**5**	The same
Seminars			**16**		**16**		**32**	**20**	Student/Student group prepares and presents the presentation on the topic, selected from the suggested list or self proposed.
Laboratory works			**16**				**16**	**8**	Preparation of laboratory work, reading and analysis of principles of experimental techniques in e-course.
1. Gene expression analysis *in situ* in transgenic *Arabidopsis thaliana* plants: induction of protein phosphatases and expression of constitutive promoter reporter gene (*E. coli* beta-GUS enzyme) in *A. thaliana* seedlings.			**8**				**8**	**4**	The same
2. Analysis of protein expression and localisation in plant cells: analysis of expression and localisation of GFP-labeled protein phosphatase PP2C in *A. thaliana* seedlings by fluorescence microscopy.			**8**				**8**	**4**	The same
Iš viso	**32**		**16**		**16**		**64**	**70**	

Assessment strategy	**Weight, %**	**Period**	**Assessment criteria**
Laboratory work	Pass/ Fail	Every third week	All laboratory works must be done, reports prepared and discussed with the instructor.
Seminars	25	November	Preparation and oral presentation of the course topic, selected from the list, which is presented by the course teachers at the beginning of course (virtual learning environment).
Midterm exam	40	November	Open answer questions in written. 2-4 (insufficient)

			5 (sufficient) 6 (satisfactory) 7(highly satisfactory) 8 (good) 9 (very good) 10 (excellent)
Exam	35	Exam session. The final exam is allowed only when all laboratory works are completed, reports prepared and discussed with the instructor.	Open answer questions in written. 2-4 (insufficient) 5 (sufficient) 6 (satisfactory) 7(highly satisfactory) 8 (good) 9 (very good) 10 (excellent)
Total	100		Seminars, midterm exam and exam parts each must be completed with the minimal evaluation (sufficient, 5) to obtain the final evaluation. The final grade is the sum of all evaluated parts.

Reading list

Author	**Year of publ.**	**Title**	**Publisher or internet address**
Main reading list			
I. Meškienė	2008	Plant Molecular Biology and Biotechnology (in Lithuanian), Teaching book, CD	Kaunas University of Technology publishing „Tehnologija“
B. B. Buchanan, W. Gruissem, R.l L. Jones	2005	Biochemistry and Molecular Biology of Plants	Wiley
Additional reading list			
-	-	http://www.blackwellpublishing.com/journal.asp?ref=1467-7644 - Plant Biotechnology (journal)	e-šaltinis
Edited by C. Neal Stewart	2008	Plant biotechnology and genetics: Principles, techniques, and Applications	University of Tennessee Knoxville