

Course name:
Biochemistry

ECTS	6
Course status	facultative
Course final assessment /evaluation of outcomes	Exam
Prerequisite	<i>Basic knowledge and skills in biology, organic chemistry and cell physiology</i>

Main field of study:

Agriculture and Horticulture, Biology and Biotechnology (Erasmus+)

Educational profile	General academic
Code of studies and education level	bachelor/engineer (SI) or master of science (SM)
Semester of studies	Winter or summer
Language of instruction	English

Course offered by:

Name of faculty offering the course	Faculty of Biotechnology and Horticulture
Name of department offering the course	Dept. Plant Biology and Biotechnology
Course coordinator	dr hab. Paweł Kaszycki, prof. UR

Learning outcomes:

Symbol of outcome	Description of the learning outcome	Reference to main field of study outcomes	Area symbol*
KNOWLEDGE – student knows and understands			
Bioch_W1	Chemical structure, properties and specific chemical tests for analysis of main groups of biochemical compounds: carbohydrates, proteins, lipids, enzymes and nucleic acids	EPB2_W02 EPB2_W04 BIOT1_W02 BIOT1_W09 BIOT1_W17	R, P
Bioch_W2	Chemical structure of plant-derived compounds: vitamins and most important plant secondary metabolites: terpenoids, (carotenoids and volatile oils), pyrrole compounds, phenolics, alkaloids and glycosides	EPB2_W02 EPB2_W04 BIOT1_W02 BIOT1_W09 BIOT1_W17	R, P
Bioch_W3	Basics of cellular metabolism: key pathways and cycles of biochemical compounds transformations, enzymatics, bioenergetics, respiration reactions and mechanisms of membrane transport	EPB2_W02 EPB2_W04 BIOT1_W02 BIOT1_W03	R, P
Bioch_W4	Synthesis and biological role of essential plant secondary metabolites, including toxic, allelopathic, health-beneficial and medicinal compounds	EPB2_W02 EPB2_W04 BIOT1_W02	R, P
Bioch_W5	Cultivation ways and techniques for sourcing plants capable of production of secondary metabolites with therapeutic or health-beneficial activities	EPB2_W04 BIOT1_W02 BIOT1_W04	R, P

		BIOT1_W07	
Bioch_W6	The most relevant characteristics of biocatalysis and distinctive features of enzymes	EPB2_W02 EPB2_W04 BIOT1_W02 BIOT1_W09	R, P
Bioch_W7	Analytical methods and study techniques regarding biochemical processes	EPB2_W04 BIOT1_W02	R, P
SKILLS – student is able to			
Bioch_U1	Plan and carry out biochemical experiments	EPB2_U01 EPB2_U02 BIOT1_U06 BIOT1_U20	R, P
Bioch_U2	Select an appropriate analytical method for the assessment of biochemical reaction	EPB2_U01 EPB2_U02 BIOT1_U10	R, P
Bioch_U3	Carry out an analysis of laboratory experimental results and interpret the data correctly	EPB2_U01 EPB2_U02 EPB2_U03 BIOT1_U04 BIOT1_U07	R, P
Bioch_U4	Search for the reference literature data using internet data-bases	EPB2_U01 EPB2_U02 EPB2_U03 BIOT1_U01 BIOT1_U03	R, P
SOCIAL COMPETENCIES – student is ready to:			
Bioch_K1	Apply the occupational safety regulations in a biochemical laboratory	EPB2_K05 BIOT1_K10	R, P
Bioch_K2	Work in a team on organizing and carrying out experimental tasks	EPB2_K02 EPB2_K05 BIOT1_K02	R, P
Bioch_K3	Constant education to broaden and update knowledge, skills and competencies	EPB2_K01 BIOT1_K07	R, P

Teaching contents

Lectures

30 hours

Topics	<p>Definition and scope of biochemistry, the elements and molecules of life, hierarchical organization of organic matter, cell structure; water as the medium of life; chemical bonds and physical forces responsible for interactions between biological macromolecules and for structural organization of cell constituents</p> <p><u>Structure and functions of substantial groups of cellular biomolecules:</u></p> <p>Carbohydrates and their derivatives, aminoacids, peptides and proteins (including peptide bond structure and protein conformational organization), fatty acids and lipids, nucleic acids (including their molecular organization as a basis for gene expression and protein synthesis).</p> <p>Biological membrane structure and dynamics; membrane transport mechanisms.</p> <p><u>Fundamentals of cellular metabolism regulation and bioenergetics:</u> biological catalysis – enzyme structure, functional and regulatory aspects, kinetic models of enzymatic action</p>
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	<p>Protein biosynthesis and mechanisms of cellular trafficking.</p> <p>Basic information on main anabolic and catabolic pathways and cycles: glycolysis, tricarboxylic acid (Krebs) cycle, electron transport chain and oxidative phosphorylation, gluconeogenesis, glycogen metabolism, pentose phosphate pathway, lipid and fatty acid catabolism.</p> <p>Presentation of enhanced information regarding main groups of cellular biochemicals, their structure, biosynthesis routes and catabolism: sugars, aminoacids and proteins, fats and lipids, nucleic acids, enzymes.</p> <p>Structural description of the most important classes of plant secondary metabolites: terpenoids, (volatile oils and carotenoids), pyrrole compounds, phenolics, alkaloids and glycosides.</p> <p>Introduction to plant secondary metabolism.</p> <p>Basic information on agricultural and herbal plant resources for industrial scale production of plant secondary metabolites.</p> <p>Biological role and the use in pharmacology and food biotechnology of the most important plant secondary metabolites: allelopathic compounds, toxins, antioxidants, anti-pathogenic agents, vitamins and coenzymes, hormones, attractants, pheromones, organic dyes of fruits and flowers, odor- and taste bearing substances.</p>
Accomplished learning outcomes	<i>EnBtB_W1-W6, EnBtB_K2, EnBtB_K3</i>
Means of verification, rules and criteria of assessment	<i>Time-restricted written exam (70% participation to the final score)</i>
Classes:	30 hours
Topics	<p>Analyses of chemical properties of biologically important molecules and biopolymers (lab classes are divided into equal-time blocks, each devoted to a particular group of biomolecules, total of 15h): saccharides and their derivatives; aminoacids, peptides and proteins; lipids and their chemical components; -soluble vitamins; nucleic acids and their chemical components; enzymes and co-enzymes, selected lipid- and water-soluble vitamins.</p> <p>Development of practical skills in laboratory methods of qualitative and quantitative analysis of biologically important plant secondary metabolites (lab classes divided into blocks, each devoted to a particular topic, total of 15h). Organic acids in fruits – determination of potential acidity in a fruit juice.</p> <p>Tillmans method for determination of ascorbate in horticultural products.</p> <p>Synthesis of selected organic esters as chemical compounds that bring smell to flowers and fruits</p> <p>Measurement of total carotenoid content in plant extracts with absorption spectroscopy</p> <p>Determination of sum of phenols in selected fruits with the Folin-Ciocalteu reagent.</p> <p>Chromatographic resolution of photosynthetic dyes extracted from a selected ornamental plant with paper partition chromatography. Identification and determination of plant dyes based on absorption spectra analyses.</p>
Accomplished learning outcomes	<i>Bioch_U1-U4, Bioch_K1-K3</i>
Means of verification, rules and criteria of assessment	<i>Evaluation of the preparedness for classes; written report on laboratory work (30%)</i>

References:

Basic	<ol style="list-style-type: none"> 1. Heldt H-W, Piechulla B., <i>Plant Biochemistry</i> 4th edn., 2011 Elsevier Inc. ISBN: 978-0-12-384986-1 2. Mathews, Van Holde, Ahern, <i>Biochemistry</i>, 3rd edn. The Benjamin/Cummings Pub. Com. Inc, 2001, CA. USA. 3. Crozier A., Clifford M.N., Ashihara H. (Eds.) <i>Plant Secondary Metabolites: Occurrence, Structure and Role in the Human Diet</i>. 2006 by Blackwell Publishing Ltd., ISBN: 9781405125093
Supplementary	<ol style="list-style-type: none"> 4. Garret R. & Grisham Ch., <i>Biochemistry</i>. 2002 5. Alberts B. et al. <i>Essential Cell Biology</i>, 2nd edn., Garland Science, LLC, 2004 6. Lehninger A.L. <i>Biochemistry</i> 4th edn., W.H. Freeman, 2005 7. Seigler D. S. <i>Plant Secondary Metabolism</i>. Kluwer Academic Publishers, 1998, ISBN: 978-1-4613-7228-8

Structure of learning outcomes

Area of academic study: R – Agricultural, forestry and veterinary sciences	3.0
Area of academic study: P – Biological sciences	3.0

Structure of student activity

Contact hours	68	hrs.	2.7	ECTS**
Including:				
lectures	30	hrs.		
classes and seminars	30	hrs.		
consultations	4	hrs.		
participation in research	...	hrs.		
obligatory traineeships	...	hrs.		
participation in examination	4	hrs.		
e-learning	...	hrs.	ECTS**
student own work	82	hrs.	3.3	ECTS**

*Areas of academic study in the fields of: H- humanities; S - social studies; P – biological sciences; T – technological sciences; M- medical, sport and health sciences; R – Agricultural, forestry and veterinary sciences; A – the arts

** stated with an accuracy to 0.1 ECTS, where 1 ECTS = 25 - 30 hours of classes