FACULTY OF CHEMISTRY

**SUBJECT CARD**

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|---|---|
| Name in English | Microbiology II |
| Main field of study (if applicable) | Biotechnology |
| Specialization (if applicable) | |
| Profile: | academic |
| Level and form of studies: | 1st level/ full-time |
| Kind of subject | obligatory |
| Subject code | |
| Group of courses | NO |

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 45 | | |
| Number of hours of total student workload (CNPS) | 90 | | 60 | | |
| Form of crediting | Examination | | crediting with grade | | |
| For group of courses mark (X) final course | | | | | |
| Number of ECTS points | 3 | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points for direct teacher-student contact (BU) classes | 1,3 | | 1,4 | | |

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Higher school level of biology.
2. Microbiology fundamentals

**SUBJECT OBJECTIVES**

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| C1 | To provide students with the knowledge about the bacterial genetics. |
| C2 | To provide students with the knowledge about the bacterial metabolisms. |
| C3 | Students is able to define and examine the physical-chemical factors influencing bacterial metabolism. |
| C4 | Students is able to plan and perform the experiments with the microbes - individually. |

**SUBJECT LEARNING OUTCOMES**

**related to knowledge:**

PEK_W01 – Students knows the rules of DNA replication in prokaryotic cells and is able to characterize the bacterial cell cycle and is able to point the reasons of differentiation in bacterial populations.
PEK_W02 – Students knows the path of protein synthesis and modification in bacterial cells
PEK_W03 – Students knows the bacterial metabolic pathways

**related to skills:**

PEK_U01 - Students is able to evaluate the influence of physical and chemical factors on the bacterial growth
PEK_U02 – Students is able to plan and make the experiments form the area of general microbiology

**PROGRAMME CONTENT**

| Form of classes - lecture | | Number of hours |
|---|---|---|
| Lec 1 | Bacterial genetics. DNA replication, plasmids characteristic. | 2 |
| Lec 2 | Bacterial genetics. Variability in bacterial cells: DNA transfers – transformation, transduction, coniugation. | 2 |
| Lec 3 | Bacterial genetics. Mutagenesis, SOS mechanism. | 2 |
| Lec 4<br>Lec 5 | Bacterial genetics. Division of the bacterial cell, bacterial colonies formation (aggregation). Protein synthesis and the control of genes expression – operons. | 2+2 |
| Lec 6<br>Lec 7 | Bacterial life cycles. Different bacterial spores. Endospore growing (*Baccilus* sp. and *Clostridium* sp.) | 2+2 |
| Lec 8 | Bacterial metabolism. Hexoses catabolism (organic donors of reductive equivalents): glycolysis, KDPG and pentoses cycles (split C6 into C3). Introduction into further metabolic pathways using C3 molecules (aerobic and anaerobic respiration; anaerobic and aerobic fermentations). | 2 |
| Lec 9 | Bacterial metabolism. Aerobic metabolism – aerobic respiration, Crebs cycle, anaplerotic pathways (glioxalic cycle), reductive equivalents synthesis. Structure, location and function of redox chain – electron transfer system; ATP restoration. Oxygen as a final electrons acceptor coming from the redox chain. | 2 |
| Lec 10 | Bacterial metabolism. Anaerobic metabolism. Aerobic and anaerobic respiration – comparison. Representative examples of anaerobic respiration: nitrate, sulphate, phosphate respirations. Mechanism of reduction of final acceptors reduction by electrons coming from the redox chain (anabolic and catabolic). | 2 |
| Lec 11 | Bacterial metabolism. Anaerobic metabolism – fermentations: alcohol, lactic, propionic, butyric. ATP synthesis – acetylphosphate as a phosphorus donor. Oxygenic fermentations – metabolic pathways leading to carboxylic acids and keto acids. | 2 |
| Lec 12 | Bacterial metabolism. Inorganic sources of reductive equivalents – electron transfer under anaerobic conditions. Reverse electron transfer – NADH and NADPH obtaining. Assimilation of carbon dioxide: Calvin cycle, reductive TCC cycle, reductive acetyl-CoA pathway. Methanogenes and methylotrphs characteristic. | 2 |
| Lec 13 | Bacterial metabolism. Photosynthetic bacterial species: chlorophylls and photosystems structures. Oxygenic and anoxygenic photosynthesis. Basics of bacterial systematics. | 2 |
| Lec 14 | Final test – I approach | 2 |
| Lec 15 | Final test – II approach | 2 |
| | Total hours | **30** |
| **Form of classes - laboratory** | | Number of hours |
| Lab 1 | Rules of lab credits. Rules of safety and work in microbial lab. | 3 |
| Lab 2 | Nutrition requirements of bacteria I. Inoculation of bacteria on minimal and complete media – intensity of growth observation and comparison of different bacterial colonies. Inoculation of chosen bacterial strains on media with different nitrogen and carbon sources. Growth observations – optimal composition of cultivation media for particular bacterial strains. | 3 |
| Lab 3 | Nutrition requirements of bacteria II. Inoculation of bacteria on minimal and complete media – intensity of growth observation and comparison of different bacterial colonies. Inoculation of chosen bacterial strains on media with different nitrogen and carbon sources. Growth observations – optimal composition of cultivation media for particular bacterial strains. | 3 |
| Lab 4 | The influence of physic factors on bacterial growth I. Optimal temperature of growth of chosen bacterial strains. Thermal lethal point assignment; influence of drying on the bacterial growth. | 3 |

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| Lab 5 | The influence of physic factors on bacterial growth II. Thermal lethal time assignment for chosen strains. The influence of UV radiation on the bacterial strains growth. | 3 |
| Lab 6 | The influence of chemical factors on bacterial growth. Optimal pH of growth assignment for chosen strains. The influence of disinfectants on the growth of chosen strains. | 3 |
| Lab 7 | Fundamentals of bacterial diagnostics – Gram staining. | 3 |
| Lab 8 | Antibiotics resistant I: Applied methods of evaluation. | 3 |
| Lab 9 | Antibiotics resistant II: application of chosen drugs. | 3 |
| Lab 10 | Bacterial metabolism I: sugars fermentation. | 3 |
| Lab 11 | Bacterial metabolism II: nitrogen metabolism, assessment of the activity of the exogenous bacterial enzymes. | 3 |
| Lab 12 | Fundamentals of yeasts cultivation and viability evaluation. | 3 |
| Lab 13 | Checking the results of previous experiments. Lab for students with absences, allowing completing the missing subjects. | 3 |
| Lab 14 | Credit – first attempt. Experimental and theoretical part. | 3 |
| Lab 15 | Credit – second attempt. Experimental and theoretical part. | 3 |
| | Total hours | **45** |

| **TEACHING TOOLS USED** | |
|---|---|
| N1 | Multimedia presentation |
| N2 | Individual laboratory work |

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation**<br>F – forming (during semester),<br>P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| P (lecture) | PEK_W01-PEK_W03 | Final test |
| P (laboratory) | PEK_U01 – U02PEK_U02 | Final test |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] P. Ketchum et all „Microbiology – Concepts and applications”
[2] Michael T. Madigan et all “Biology of Microorganisms”
[3] „Mikrobiologia” ; H.G. Schlegel

**SECONDARY LITERATURE:**

[1] „Życie bakterii” W. Kunicki-Goldfinger,
[2] „Bakterie w biologii, biotechnologii i medycynie” P. Singleton,

**SUBJECT SUPERVISOR**
(NAME AND SURNAME, E-MAIL ADDRESS)

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