(SYLABUS)

Name of the department / clinic providing the course:
Department of Cell-to-Cell Communication

Course title: Międzynarodowa Szkoła Doktorska

Course profile: academic

Speciality: -

Level of course unit: Doctoral School

Course unit title: From Monolayers to Mini-Organs – Advances in 2D and 3D Cell Culture Models

Course unit code:

Course aims:
This course introduces students to the principles and applications of cell culture models, with a particular focus on the transition from traditional two-dimensional (2D) systems to advanced three-dimensional (3D) models. The aim is to provide students with a critical understanding of the strengths and limitations of 2D and 3D culture systems, their methodological foundations, and their relevance for translational research. Students will gain knowledge of practical techniques, emerging technologies, and case studies that illustrate how culture models are applied in cancer research, disease modeling, and personalized medicine. By the end of the course, students will be able to evaluate the suitability of different cell culture approaches for specific research questions and be aware of current challenges and future directions in the field.

Form of study: Stacjonarne

Year of study: 1

Types of educational activities and number of hours allocated: 10 hours of seminar (online)

Number of ECTS credits allocated and their structure according to students' from of learning:

Names of course unit's faculty: dr n. biol. inż. Marta Biesiekierska

Prerequisites: Knowledge of the English language at B2 level (at least)

Learning activities and teaching methods: Presentation, active communication

Course unit content:
1. Foundations of Cell Culture
2. 2D Cell Culture: Principles and Pitfalls
3. Why and How to Move to 3D Models
4. Techniques for 3D Cell Culture
5. Applications and Future Directions

Course objectives:
Knowledge:
By the end of the course, students will be able to:

- explain the historical development and significance of cell culture in biomedical research,
- describe the basic requirements for maintaining cell cultures, including media composition, pH, atmosphere, and aseptic techniques,
- distinguish between 2D and 3D cell culture systems and evaluate their advantages and limitations,
- understand key applications of 2D and 3D models in translational research, including cancer biology, neurodegeneration, and personalized medicine,
- outline major techniques used in 3D culture (scaffold-based and scaffold-free approaches),
- recognize current challenges in standardization, scalability, and reproducibility of cell culture models,
- identify emerging directions such as organ-on-chip systems and 3D bioprinting.

Skills:
By the end of the course, students will be able to:

- critically assess the suitability of 2D vs 3D culture models for specific research questions,
- interpret case studies comparing experimental results from 2D models, 3D models, and *in vivo* systems,
- apply theoretical knowledge to design experimental strategies using appropriate culture systems,
- communicate scientific concepts related to cell culture models clearly, using appropriate terminology and visual representations (e.g., experimental workflows),
- engage in discussion about the opportunities and limitations of advanced cell culture technologies in biomedical research.

Attitudes and transferrable (generic) competencies:
By the end of the course, students will:

- adopt a critical and reflective approach to evaluating experimental models,
- recognize the importance of accuracy, reproducibility, and biosafety,
- enhance critical thinking and problem-solving skills by analyzing case studies and comparing experimental models,
- be aware of innovative and interdisciplinary methods in biomedical research.

Required and recommended learning resources (readings):
Required:

- Koledova, Z. S. (Ed.). (2024). 3D Cell Culture: Methods and Protocols (2nd ed.). Humana Press.
- Kasper, C., Charwat, V., & Lavrentieva, A. (Eds.). (2018). Cell Culture Technology. Springer.
- Lin, J.-M. (Ed.). (2018). Cell Analysis on Microfluidics. Springer.

Recommended:

- Oliveira, J. M., & Reis, R. L. (Eds.). (2020). Biomaterials- and microfluidics-based tissue engineered 3D models. Springer.
- Perrett, S., Buell, A. K., & Knowles, T. P. J. (Eds.). (2019). Biological and bio-inspired nanomaterials: Properties and assembly mechanisms. Springer.

Assessment methods and criteria: Attendance at the seminar

Rules for making up absences from classes: Meeting during which the PhD student demonstrates their knowledge of the material (e.g., through a brief discussion).

Additional information:
Contact person: dr n. biol. inż. Marta Biesiekierska, marta.biesiekierska@umed.lodz.pl

Statement and signature of the course leader:
I hereby state that the content of the curriculum included in the syllabus below is the result of my individual work completed as part of work contract/cooperation resulting from a civil law contract, and that author rights to this title are not the property of a third party.

Dean's signature:

Data: