SYLLABUS

Name of the department / clinic providing the course:

Department of Molecular Biology

Course title:

Stem Cells in Personalized and Cellular Therapies

Course profile:

Academic

Speciality:

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Level of course unit:

International Doctoral School

Course unit code:

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Type of course unit:

Elective

Course aims:

The aim of the seminar is to provide doctoral students with an advanced understanding of the biology of stem cells, their differentiation and reprogramming, and their application in current and future therapies. Particular focus will be placed on their role in personalized and cellular medicine, including the development and application of CAR-T cell therapy.

Form of study:

On-line

Year and semester of study:

Summer semester

Types of educational activities and number of hours allocated:

Lecture Seminar Practical / Activity E-learning Self-study ECTS points

Seminar: 10 h

Subject Language:

English

Names of course unit's faculty:

Faculty of medical biology/ Department of Molecular Biology

Prerequisites:

Basic knowledge of cellular and molecular biology, immunology, and genetics

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Learning activities and teaching methods:

- Seminar: verbal communication, multimedia presentation
- Practical part: scientific article analysis, group-based worksheet ("karta pracy"), discussion and case analysis, brainstorming future applications

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Course unit content (2x5-hour seminar):

Thematic blocks:

1. **Introduction to Stem Cell Biology**
    - Types of stem cells: ESC, iPSC, adult stem cells
    - Concepts of potency: totipotent, pluripotent, multipotent
2. **Differentiation and Reprogramming**
    - Molecular control of lineage specification
    - iPSC technology: methods and applications
    - Epigenetic regulation of cell fate
3. **Stem Cells in Regenerative and Cellular Therapies**
    - Clinical applications of stem cells: current state and future trends
    - Safety, ethical and regulatory challenges
4. **Stem Cells and Personalized Medicine**
    - Patient-specific iPSCs ad their derivatives in disease modeling and drug screening

- Patient-specific iPSCs ad their derivatives and clinical applications

5. **CAR-T Therapy and Stem Cells**
    - Overview of CAR-T cell therapy
    - The role of stem cells and iPSCs in next-generation CAR-T development
    - Future perspectives in onco-immunology

On-line practical component:

Interactive student activity (approx. 2 hours per semminar):
Students will work in small groups with a **worksheet ("karta pracy")** that includes:

- Analysis of a short research article or abstract (related to iPSC or CAR-T)
- Identification of the therapeutic mechanism and research aim
- Mapping the use of stem cells in therapy pipeline (from collection to application)
- Creative task: **designing a hypothetical personalized stem cell therapy** for a selected disease (e.g. Parkinson's, leukemia, type I diabetes)

Course objectives:

Knowledge

After completing the seminar, the student:

- Understands the classification and functional characteristics of different stem cell types
- Knows the principles of cellular reprogramming and differentiation
- Understands the role of stem cells in modern therapeutic strategies including CAR-T

Skills

After completing the seminar, the student is able to:

- Analyze and critically interpret scientific literature in the field of stem cell biology and therapy
- Evaluate therapeutic approaches based on stem cells
- Apply knowledge to design potential therapeutic concepts based on patient-specific cells

Attitudes and transferrable competencies

The student is ready to:

- Collaborate in interdisciplinary teams in translational medicine projects
- Critically evaluate research achievements and their clinical significance
- Apply personalized approaches to patient treatment planning using cellular technologies

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Required and recommended learning resources (readings):

Required:

1. **Lanza, R. et al. (2021). *Essentials of Stem Cell Biology*. Academic Press.**
2. **Yamanaka, S. (2012). Induced pluripotent stem cells: past, present, and future. *Cell Stem Cell*, 10(6):678–684.**
3. **June, C.H. et al. (2018). CAR T cell immunotherapy for human cancer. *Science*, 359(6382):1361–1365.**

Recommended:

1. Trounson, A., DeWitt, N. (2016). Pluripotent stem cells progressing to the clinic. *Nature Reviews Molecular Cell Biology*, 17(3):194–200.
2. Ghosh, Z., Huang, M., Hu, S. (2021). Personalized regenerative medicine: Advances in iPSC-based therapy. *Trends in Molecular Medicine*, 27(3):212–228.
3. Publications from *Nature Biotechnology*, *Cell Stem Cell*, *Frontiers in Immunology*

Assessment methods and criteria:

- Attendance and active participation – 40%
- Completion of the worksheet / group project – 60%

No formal exam; pass/fail grade based on engagement and completion of tasks.

Additional information:

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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 a work contract/cooperation resulting from a civil law contract and that author rights to this title are not the property of a third party.
