Study programme(s): **PhD in Biology**

Level: **Doctoral degree**

Course title: **MOLECULAR EVENTS & SIGNALING PATHWAYS IN REGULATION OF MITOCHONDRIAL BIOGENESIS**

Lecturers: Prof. Dr Silvana Andric, Prof. Dr Tatjana Kostic

Status: **Elective**

ECTS: **15**

Requirements: -

Learning objectives

Objective of this course is to acquire knowledge about the molecular mechanisms and signaling pathways and their interactions in the regulation and synchronization of mitochondrial biogenesis. Students should gain the ability in scientifically based interpretation of the experimental data from the field of regulation of mitochondrial biogenesis.

Learning outcomes

At the end of this course students will be able to understand and describe the general features of the mitochondrial biogenesis, intracellular signaling properties and methods of network detection, transduction, transmission, propagation and amplification of information in order to achieve adequate control of mitochondrial biogenesis, as well as to acquire the capacity for analysis and discussion scientific papers in the field.

Syllabus

Theoretical instruction

Functional morphology of mitochondria and overview of processes that maintain homeostasis of the mitochondria. Basic characteristics of mitochondrial biogenesis. Mitochondrial genome. Regulatory proteins involved in transcription of mitochondrial genes. Transcriptional regulators of mitochondrial proteins encoded by nuclear genes: the key role of NRF-1 and NRF-2. The key role of transcription in the regulatory cascade coactivator of mitochondrial biogenesis: PPAR coactivator-1 (PGC-1) family. Signaling pathways that activate PGC-1. Network of signaling pathways and regulatory proteins on the relation mitochondria-nucleus. Molecular events that regulate mitochondrial biogenesis in extreme conditions (physical and psychological stress, cold, starvation, excessive physical exertion, illness). Regulation of mitochondrial biogenesis in the metabolic syndrome and aging.

Practical instruction – Students research work

Each student will have an individual project assignment in the research related to the molecular events that regulate mitochondrial biogenesis. The degree of mitochondrial biogenesis will be determined by monitoring the number of mitochondria (MitoTrack assay), transcription analysis and analysis of expression and interaction of regulatory proteins. The various *in vivo* experimental models that mimic situation in human populations will be used.

Seminars. Short presentation of the specified topics connected with the subject of student's PhD thesis.
Journal Club. Presentation of the original peer-review scientific paper from the field.

Recommended Literature:

Miller BF & Hamilton KL (2012) *A perspective on the determination of mitochondrial biogenesis*. Am J Physiol Endo Met 302: E496–99.

Piantadosi CA & Suliman HB (2012) *Redox regulation of mitochondrial biogenesis*. www.sciencedirect.com/science/article/pii/S0891584912011392

O'Neill HM, Holloway GP & Steinberg GR (2012) *AMPK regulation of fatty acid metabolism and mitochondrial biogenesis: Implications for obesity*. Mol Cell Endo www.sciencedirect.com/science/article/pii/S0303720712003334

Herrmann JM, Longen S, Weckbecker D & Depuydt M (2012) Biogenesis of Mitochondrial Proteins www.springerlink.com/content/n1l0202h5043k532/

Medeiros DM (2008) Assessing Mitochondrial Biogenesis http://krex.k-state.edu/dspace/bitstream/handle/2097/1042/MedeirosMethods2008.pdf;jsessionid=60C921DE4C5258682936D254CF5C15C3?sequence=5

Leuenberger D, Curran SP & Koehler CM (2005) *Mitochondrial Biogenesis* in The Biogenesis of Cellular Organelles. Springer
Koehler CM & Bauer MF. (2004) *Mitochondrial Function and Biogenesis Series* in Topics in Current Genetics Vol.8. Springer
Review peer-review scientific paper from the field of mol. events & signaling path. in regulation of mitochondrial biogenesis.

Weekly teaching load				Other:
Lectures: 2	Exercises:	Other forms of teaching: 3	Student research: 5	

Teaching methodology

Theoretical part – Lectures/Consultative discussions. *Students research work* – participation in the planning and execution of the experiments and the analysis, interpretation and discussion of the experimental results from the field of molecular events & signaling pathways in regulation of mitochondrial biogenesis. *Seminars* - Short presentation of the specified topics connected with the subject of student's PhD thesis. *Journal Club.* Presentation of the original peer-review scientific paper from the field.

Grading method (total number of points 100)

Scientific project problem – up to 30; *Seminar* – up to 5; *Presentation of the original scientific paper (Journal club)* – up to 20; *Oral exam* – up to 45.