

MOLECULAR ONCOLOGY

Course Workload		Assessment form (examination/ graded test/ ungraded test)
ECTS	Hours	
3	108	Ungraded test

Students will know how to formulate the basic concepts of molecular oncology; to describe the main molecular signs of cancer; to substantiate the methods of control and coordination of the activities of co-executors; to formulate the basis for the organization of joint research activities on molecular oncology; to describe changes in the metabolism of tumor cells, changes in the immune system in cancer; to reproduce the mechanisms of regulation of the cell cycle, the mechanisms of invasion, metastasis and angiogenesis; to formulate current trends and prospects for the development of production of targeted drugs.

Course structure:

1. INTRODUCTION TO MOLECULAR ONCOLOGY. SIGNS OF CANCER. ONCOGENES AND TUMOR SUPPRESSORS
 - 1.1. The main molecular signs of cancer.
 - 1.2. Viral, chemical and genetic mechanisms of carcinogenesis.
 - 1.3. Oncogenes and tumor suppressors.
2. GROWTH FACTORS AND INTRACELLULAR SIGNALING
 - 2.1. Kinases and phosphatases in the transmission of intracellular signals.
 - 2.2. Tyrosine kinases and serine-threonine kinases.
 - 2.3. Growth factors and receptors for growth factors. MAPK, PI3K/AKT signal stages.
 - 2.4. Transcription factor Myc.
3. THE CELL CYCLE
 - 3.1. The cell cycle.
 - 3.2. Regulation of the cell cycle.
 - 3.3. Cyclins and cyclin-dependent kinases.
 - 3.4. Cell Cycle Checkpoints.
 - 3.5. Inhibitors of cyclin-dependent kinases.
 - 3.6. Methods study of the cell cycle.
4. CELL DEATH: APOPTOSIS, NECROSIS, AUTOPHAGY, ETC.
 - 4.1. Mechanisms of programmed cell death
 - 4.2. Structure of apoptotic signaling cascades
 - 4.3. Programmable necrosis
 - 4.4. Induction of autophagy
 - 4.5. Mechanisms of induction of cell death by antitumor drugs

5. ANGIOGENESIS, INVASION AND METASTASIS

- 5.1. VEGF signaling pathway.
- 5.2. Hypoxia.
- 5.3. HIF transcription factors.
- 5.4. Epithelial-mesenchymal transition.
- 5.5. Matrix metalloproteinases.
- 5.6. Transcription factors Snail, Slug, Zeb1 and Twist.
- 5.7. Invasion and metastasis.
- 5.8. Prometastatic niches.

6. CELLULAR METABOLISM

- 6.1. The Warburg Effect.
- 6.2. Glycolysis and oxidative phosphorylation in a tumor cell.
- 6.3. Glutamine metabolism.
- 6.4. NO and reactive oxygen species.
- 6.5. Inhibitors of metabolism in tumor cells.

7. GENETIC INSTABILITY AND DNA REPAIR

- 7.1. Genetic instability of tumor cells.
- 7.2. Ways of DNA damage repair.
- 7.3. NHEJ and HR repair paths. MR, XR, BER repair paths.
- 7.4. Synthetic lethality.
- 7.5. DNA-damaging agents in therapy.
- 7.6. Repair inhibitors in therapy.

8. CANCER STEM CELLS AND CANCER IMMUNOLOGY

- 8.1. Tumor stem cells.
- 8.2. Notch, Wnt, Hedgehog signal cascades.
- 8.3. T cells, NK cells and macrophages in tumors.
- 8.4. T-regulatory cells.
- 8.5. PD-1 and CTLA 4 inhibitors.