

Molecular Oncology (MMD-994)

Credit Hours 3 (3-0)

Course Description

Molecular oncology is an interdisciplinary medical specialty at the interface of medicinal chemistry and oncology that refers to the investigation of the chemistry of cancer and tumors at the molecular scale. Also the development and application of molecularly targeted therapies

To understand the promise of molecular oncology, it is useful to examine what it has achieved so far and to see how current developments will lead to the realization of the above goals. The molecular genetic analysis of cancer has delivered some clear truths on which the rational approach to cancer research must now be based. The clonal nature of the disease, the progressive accumulation of additional mutations associated with the progression of malignancy, the interaction of different genetic alterations, and complementation between different mutant genes are all established beyond reasonable doubt.

Educational Objective

- The aim of the course is to provide an in-depth understanding of the molecular mechanisms underlying the development of cancer.
- The course will provide students with the knowledge and training needed to approach and formulate scientific questions relevant to the cancer biology.
- The course will also survey the frontiers of cancer research and aims to make the students accustomed to the applied advanced methods, technologies and state-of-the-art web-tools used in cancer research.

Course Outcomes

- Describe general principles of cancer diagnostics and treatment,
- Understand the basic processes underlying the transformation of a normal cell to its malignant
- Counterpart, and the consequences of malignant transformation on the cellular and organism level,

- Understand how the biological knowledge of cancer development is used in modern cancer
- Treatment,
- Show knowledge and skills in laboratory techniques used in experimental cancer research,
- Demonstrate knowledge in cancer epidemiology,
- Use basic epidemiological research methods and describe their importance in complementing other (e.g., laboratory) research investigations,
- Use the principles of good experimental design to plan valid and efficient experimental studies,
- Have knowledge about and be able to discuss ethical aspects in research.

Course Contents

1. Tumor biology: Causes of cancer. Cancer related genes,
2. Oncogenes and tumor suppressor genes; their normal cellular function,
3. Mutagenesis and consequences of mutation in cancer.
4. Hereditary cancer. The stepwise transformation process.
5. The biological behavior of tumors.
6. Cell cycle control and apoptosis.
7. Tumor progression and metastasis.
 - Formation of Metastases
 - Routes of Metastasis
 - Spread of Cancer through the Lymphatic System
 - Organ Targeting: Anatomic vs Seed & Soil Models
 - The Seed and Soil Hypothesis
 - How Metastases Form New Tumors (Colony Formation)
 - Obstacles to Colony Formation
8. Introduction to the Tumor-Host Interactions
 - Overview of the Tumor Microenvironment

- Conditions within the Tumor Microenvironment
- Inflammatory Cells and Cancer
- Matrix Metalloproteinases and Cancer

9. Angiogenesis and tumor development

- Apoptosis and its role in growth regulation, Senescence
- Chromosomal changes
- Gene amplification
- Epigenetic changes

10. The interaction between malignant and normal cells. Tumor virology. Research methodology.

11. Malignant diseases. Diagnosis.

12. Molecular tumor pathology.

13. The major treatment principles of cancer (surgery, radiotherapy, hormonal treatment, and biological therapy).

14. Novel and developing treatment strategies.

15. Ethics. Palliative treatment. Cancer epidemiology. Prevention. Clinical trials.

Recommended Books

1. Gelmann, E. P., Sawyers, C. L., & Rauscher III, F. J. (Eds.). (2013). *Molecular oncology: causes of cancer and targets for treatment*. Cambridge University Press.
2. Ruddon, R. (2010). *Molecular biology of cancer: translation to the clinic*. Academic Press.
3. Weinberg, R. A. The biology of cancer. 2007. *New York: Garland Science, 1*.
4. Bronchud, M. H., Foote, M. A., Giaccone, G., Olopade, O., & Workman, P. (Eds.). (2008). *Principles of molecular oncology* (Vol. 2). New Jersey:: Humana Press.